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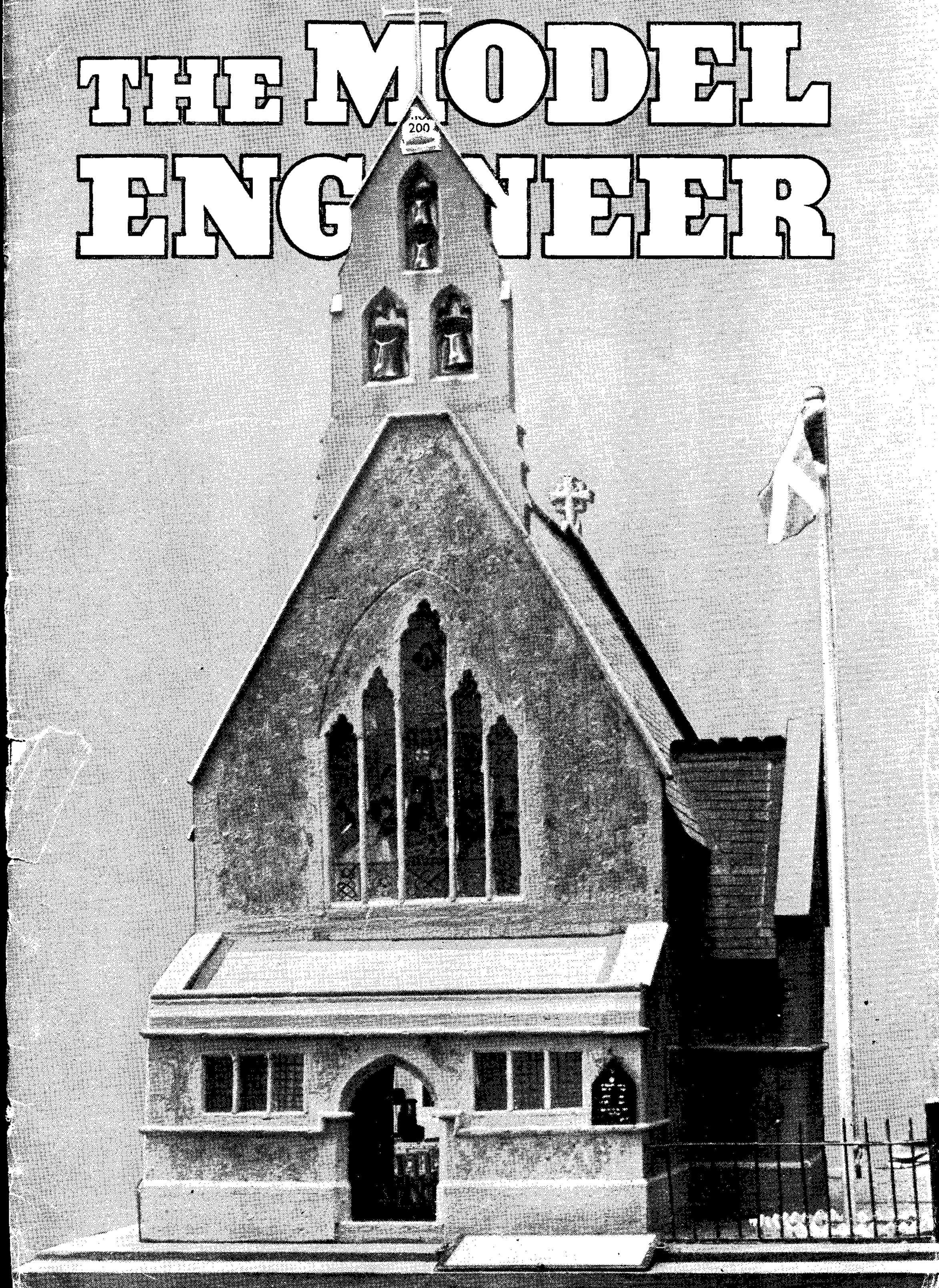
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

17TH JANUARY 1952 VOL. 106 NO. 2643

SMOKE RINGS

The 1952 "Model Engineer" Exhibition

● IT IS perhaps not too early to remind readers of the dates of the 1952 "M.E." Exhibition, which will be held as usual in the New Royal Horticultural Hall, Westminster, from August 20th-30th inclusive. Plans are already well under way to make this the finest show ever.

Be sure that you allow yourselves ample time to complete your exhibits, and do bear in mind that it assists us, the organisers, considerably if good, glossy photographs of your model are included when returning the entry forms.

A Good Start

● MINIATURE GRAND PRIX is off to a good start if the enthusiasm expressed in correspondence is anything to go by. There have been several meetings, too, to discuss the future of the sport, and word has come in that a number of tracks will be in operation in 1952, including one in Switzerland, from which quarter we might expect some encouragement for an international event.

Now if M.G.P. is to develop and progress along rational lines, it is obvious that serious thought must be given to control; and since the tools of the sport, the models themselves, are designed closely to represent the prototype, it is perhaps not unreasonable to suggest that, where practicable, the rules which govern full-size racing should apply. To this end, the question of formula should not be overlooked. For instance, since a maximum capacity of 1.5 c.c. has been decided upon, this class should be known as Formula I, and should include only models, to 1 in. scale, of full-sized Formula I cars, such as Alfa Romeo, B.R.M., Maserati, E.R.A., Lago Talbot, Ferrari, etc. The smaller cars, powered by 0.75 c.c. engines should be Formula II, and there could also be a 0.5 c.c. class to represent Formula III or the "500's." In each case the models should conform to the prototypes in these classes, and the miniature events could be staged with corresponding realism and authenticity.

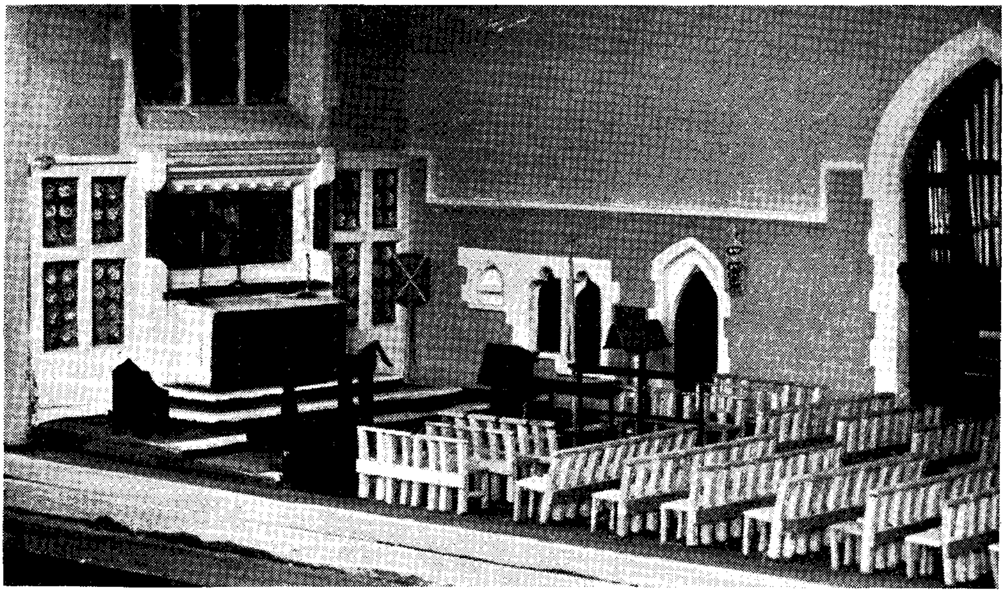
We should be interested to have readers' views on this subject.

Musical Boxes

● FOR THE benefit of our many correspondents who write in for information on musical boxes, we are pleased to be able to announce a useful handbook, recommended by one of our readers, entitled *Musical Boxes* by John E. T. Clark, published by Cornish Brothers Ltd., Birmingham. This is a small book of 70 pages, which touches on musical boxes, musical clocks, singing birds, etc., and concludes with a list of makers.

Our Cover Picture

● THIS INTERESTING architectural model was constructed as a team effort by the Gravesend Aeromodelling Club, supervised by Mr. A. O. Pollard, Snr. Its original purpose was in connection with the Gravesend Festival of Britain Exhibition. It is a fully detailed scale model of the St. Andrew's Waterside Mission Church, at Gravesend, to a scale of ½ in. to 1 ft., and occupied a space of 3 ft. × 2 ft. As may be gathered from the photograph, the general effect and details are very realistic, including a faithful reproduction of the stained glass windows, and the further photograph reproduced on this page shows the completeness of the interior fittings. This model was on show at the 1951 "M.E." Exhibition, and was awarded a V.H.C. diploma.



Model Speed Boat Progress

● THE ENTRIES for the 1951 "M.E." Speed Boat Competition have now been received, and the results are being classified and prepared for publication. A preliminary survey of the entries reveals the fact that noteworthy progress has been made in all classes, and there are now several boats which have attained speeds of well over a mile a minute, a performance which would have been considered fantastic only a few years ago. Those who have tried it will know that speed is more difficult to achieve on or in water than in any other medium, and there is a saying among navigators that "the last knot takes double the power"; it is, therefore, a tribute to the skill and perseverance of the model power boat fraternity to record that average speeds have more than doubled in the course of twenty years, nearly half of which time was lost through difficulties associated with the war and its aftermath. It is also worthy of note that the results in this competition have been attained with boats built entirely by the competitors, including both hulls and engines, and that these approach very closely the best performances attained with manufactured engines, both in this country and abroad. The main factor in the achievement of these high speeds is, undoubtedly, the improved efficiency of small engines, which are now capable of phenomenal r.p.m. and power, but it has also been necessary to experiment untiringly with the design of the hulls in order to keep them on the water, with light loading, and utilise the available power. A fully detailed and illustrated report of the competition will appear in an early issue of THE MODEL ENGINEER.

Quite a Youngster

● A LETTER from Portugal mentions a 0-6-0 locomotive which the writer sees occasionally working freight trains on the Lisbon-Azambuju section of the Compania Portuguesa de Caminhos de Ferro; the engine bears the makers' plate of Beyer Peacock, Gorton Foundry, and the date 1896, and our friend writes: "I wonder if any reader of THE MODEL ENGINEER knows of an older working locomotive."

We most certainly do. At the present time, there are probably some hundreds of locomotives dating from the 1870s and still working. Many of them have, of course, been rebuilt and, as far as possible, brought more up to date in details. Probably, the majority are 0-6-0 tender or tank engines, and they are to be found in France, Spain, Belgium and Germany as well as in Great Britain. As recently as last November, Britain's oldest engine of this type, No. 58110, one of the celebrated "Kirtley Goods" of the old Midland Railway, was withdrawn aged 85, and she was one of a batch of 315 that Derby began to build in 1863; so the Portuguese engine is quite a youngster.

"Magna Charta"
A $2\frac{1}{2}$-in. Gauge "First Timer"

by Victor Hotchkiss

A LOVE and admiration for old-time locomotives with their predominant decoration, however useless, created the desire to build one for myself.

For many years I have been a keen model maker and amateur craftsman but had not tackled a live steam locomotive.

came within the capacity of my tools and equipment.

Drawings were begun with many references to THE MODEL ENGINEER back numbers for cylinder and boiler dimensions, and to the "know how" from most helpful "L.B.S.C."

My greatest qualm was the narrow space I

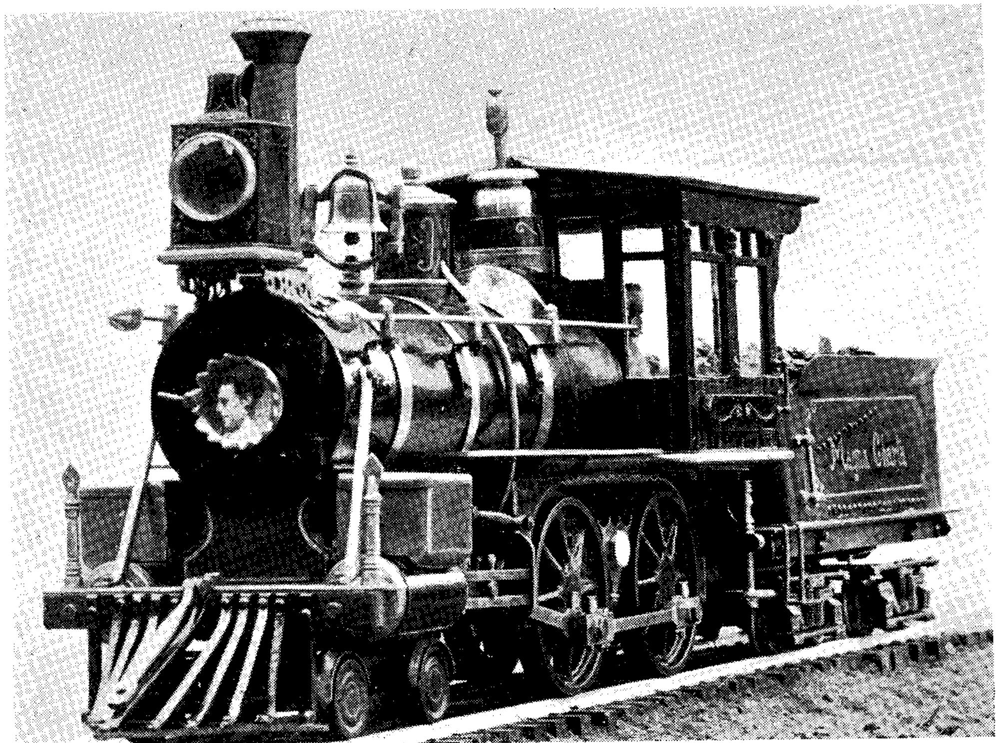


Photo by] [F. Braby

A front-side view of "Magna Charta." The photograph on the front of the smokebox is typical of the period when the President of the railroad had his picture on the engine

had between frames to accommodate the firebox. A perusal of the dope on *Wee Dot* (coal-fired) and *Tich*, decided me on taking a chance.

An American 4-4-0 type locomotive of the 1870-75 period caught my fancy for "prettiness" and style, and, most important, there was available sources of information, both photographic and explanatory.

My workshop consists of modest equipment regarding machine tools. The Adept $1\frac{5}{8}$-in. lathe (motorised) with three- and four-jaw chucks and all its available accessories was my turning and boring tool.

A $\frac{1}{2}$-in. capacity motorised bench drill was my drilling and tapping gear, plus the usual hand tools, vice and indispensable micrometer.

$2\frac{1}{2}$-in. gauge, $\frac{1}{2}$-in. scale was adopted, as this

The frames are the American bar-frames cut from solid steel, $\frac{3}{16}$ in. thick, with saw and file, and leaves $1\frac{3}{8}$ in. for the outer firebox!

Steel end beams were joined to the frames with angles and $\frac{1}{16}$-in. iron rivets. Axleboxes were next, and were built up, using brass bar, faced in the lathe and silver-soldered to $\frac{1}{16}$-in. brass plate to form guide flanges.

I deemed that the frames were thick enough to dispense with horns. The axleboxes were then drilled and reamed, and sprung from below

with the usual nutted pin and spring. Springs above the frames are dummy.

Driving wheels had to be made from special castings as no commercial wheel could be adapted to the design.

Not trusting my hand at "solid" pattern-making, I built mine up in three sections.

First I turned, from mahogany, the rim, flange and tread in the form of a ring, then a flat disc which fitted closely into the ring. Spokes were marked and cut out of this disc, leaving, of course, the balance-weight which occupied the space between three spokes, as seen in the close-up photograph.

Another similar disc was turned, and from this all the spokes were cut and shaped on their outer faces to the curved spoke section. The last, and balance section, were glued on top of each other, so giving me the spoke pattern over the balance weight, and these in turn glued at their outer edges to the inside face of the ring.

This made a good pattern and was taken to a local foundry who undertook to cast my wheels for me, and they made a very good job of them.

The original engines of this period had cross-head pumps, and likewise mine had to have the same. My first pump was made from brass having $1\frac{1}{8}$ in. stroke, $\frac{1}{8}$ in. bore, and incorporated top and bottom valves. This pump worked well in a saucer of water.

The front bogie, or truck, was built up from steel strip and has sprung compensated axleboxes, also built up. Small solid steel wheels were cut from bar, turned and pressed on to the axles.

With driving wheels now returned, work on them was started. My little lathe shied at them until I ground off most of the outer skin, which helped a lot.

Slip eccentrics were used on the front driving axle to actuate the valve-gear *via* a rocker shaft. (See close-up photograph.) This rocker shaft runs in small brass bearings bolted to the top of the frames. Cylinders are made from the solid, having $1\frac{1}{8}$ in. stroke $\times$ $\frac{5}{8}$ in. bore. My only regret now is that I did not make patterns and have them cast. The bore was got to size by using progressively expanding reamers, which my kind neighbour lent me.

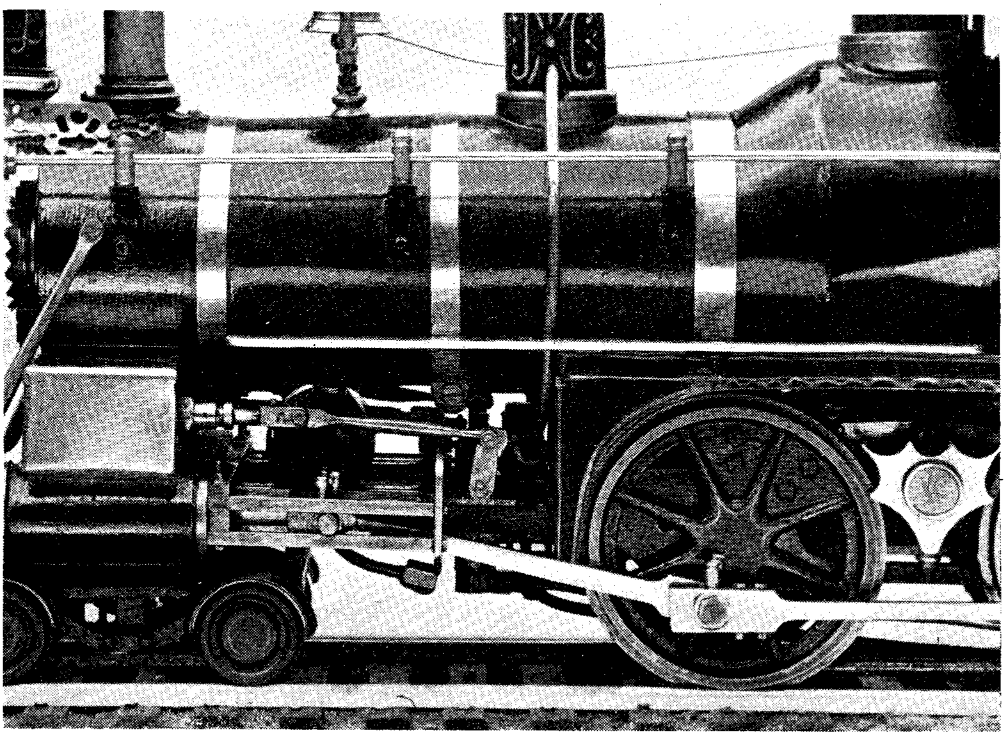


Photo by] [*F. Braby*

Close-up of wheels, valve-gear, etc.

Whilst waiting for my castings, I tackled the "pilot" or "cow-catcher." This was built on a triangular base frame upon which was riveted with $\frac{1}{16}$-in. iron rivets, the bars. These bars were heated to red and hammered to shape and drilled. The top ends of the bars are riveted to the front beam.

Valve ports were nibbled a bit, but have since been refaced with brass plate having ports more neatly and accurately cut.

It was quite a fiddle getting the crosshead pump in between the front driver and guide plate, and also fixing a drive to the ram.

The crosshead guides were a bit awkward,

as there were four guide bars to each cylinder, and several ideas were tried before I decided to make the guides and plate a separate unit, which was bolted to the frames with small angle-pieces.

When all was assembled and the motion timed, a cycle pump was connected to the steam pipe and a sharp stroke spun the wheels quite snappily.

small cocoa tin blower, using a "meth" burner.

This helped a lot, but for the best results in starting such a small fire I had to wait until I had acquired some charcoal. This, when soaked in paraffin and the blower going, raised 10 lb. of steam in about five minutes from cold. I fed the firebox charcoal, which it ate like a glutton. When the engine's own blower got

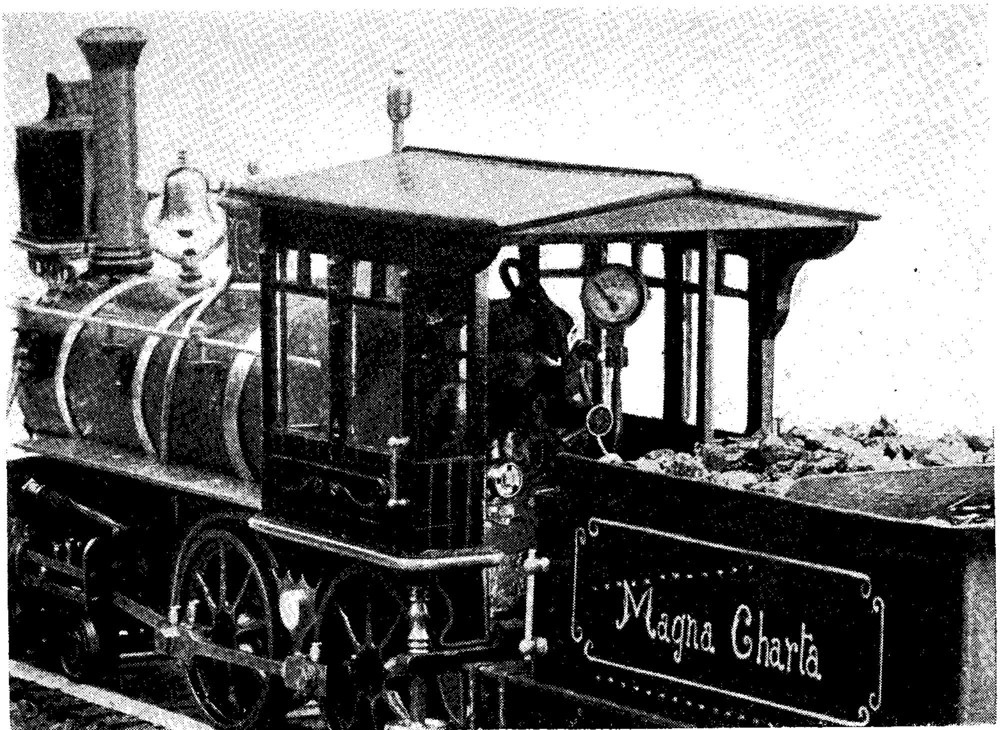


Photo by] [*F. Braby*

A three-quarter back view, showing wooden cab and fittings

The boiler is from "L.B.S.C.'s" designs and its fittings from his *Live Steam Book*.

Boiler former-plates were cut from $\frac{3}{8}$-in. aluminium plate which I had by me and they proved very successful with softened copper sheet.

The inner firebox was joined up with $\frac{1}{16}$-in. copper rivets and silver-soldered with coarse-grade solder, using two blowlamps and a biscuit tin of coke as a hearth.

Completion of the boiler was by rivets and silver-solder. It has six $\frac{3}{8}$-in. fire-tubes and one $\frac{5}{8}$-in. superheater flue.

Under test, a few weeps were seen and stopped with soft solder. Bronze stays are used on end plates and at the firebox sides.

Smokebox and chimney were made, and the boiler and chassis was connected up and a test made. Not being used to firing a small boiler, or any boiler at that, I had difficulty in starting and keeping a fire, using a cycle pump and chimney as an auxiliary blower. Reference to back numbers of THE MODEL ENGINEER (February 25th, 1932) "L.B.S.C." gave me a

going, anthracite crushed to pea size was shovelled on. I found that the anthracite needed a hefty draught to keep it bright; also, it took too much steam, and it seemed to fuse and cake together.

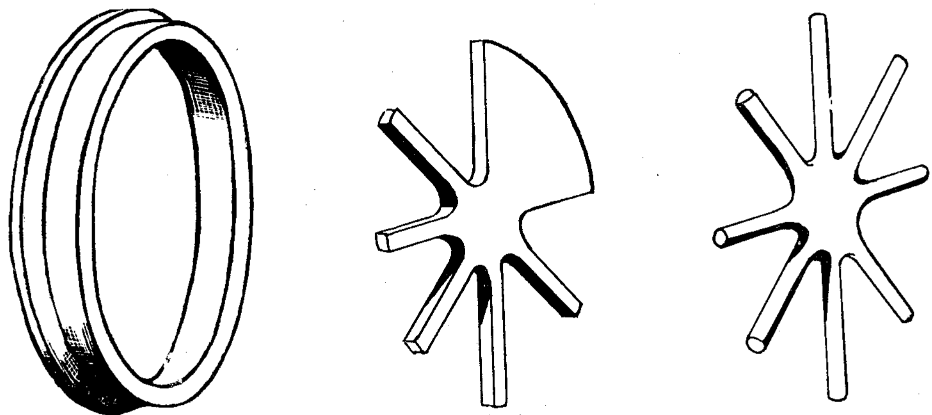
Under these conditions, a fair trial was made on a short length of track.

Now, being "green" at such things, I still found that I could not make enough steam to meet the demands of the cylinders.

This worried me until our coalman delivered some stuff that *looked* like coal! A good size knob of this was broken up and tried—my! What a difference.

The fire burned bright to the firebars, and she kept blowing at the safety-valve during running and the "clock" kept on the right side of 50 lb. with the blower just a whisper when standing. With anthracite, the blower was hard on most of the time! In describing this firing experience, I feel a lot more helpful firing hints by some of the experts would be greatly appreciated by some of us "learners."

These short trials were all right regarding



Sketches of wheel pattern

actual working, but the crosshead pump was not pushing enough water into the boiler. In the *Live Steam Book*, some nice little pumps are described, one of which I made and fitted between frames. This was tricky for me, as I had to make a divided eccentric because my wheels were pressed on. Anyway, the pump has proved most satisfactory and employs top-feed, which goes under the centre dome.

The cab is in mahogany-faced ply and glazed with old photographic plates.

The tender is a fairly straightforward job having a hand pump (*Live Steam Book*) with feeds for side clack valve, axle-driven pump and by-pass return, three connections in all.

Tender bogies are built up and the eight wheels were sawn from a motor-car shaft and turned.

All the adornments, knobs, domes, bell, etc., were hand turned, using ground-up files as tools. I like this form of turning.

Small unions were a bit tricky to make nice and accurate, so a lot of my pipe connections have flange and washer joints with union nuts for tightening.

This model has given me great pleasure to construct over a period of two years and I have learnt a lot, and made a few mistakes.

My wife shares my enthusiasm and that means a great deal to one who, after having tea, vanishes into the workshop !

Whimsical Workshop Warnings

by Rick Elmes

IF YOU **MUST** *SAW IN THE LATHE, PLACE SOME WOOD*
ON THE LATHE BED—IS THAT UNDERSTOOD?
IF YOU DON'T TAKE THIS TIP
AND YOU **DO** *MAKE A SLIP—*
WELL, IT WON'T DO THE LATHE BED MUCH GOOD!

Model Power Boat News

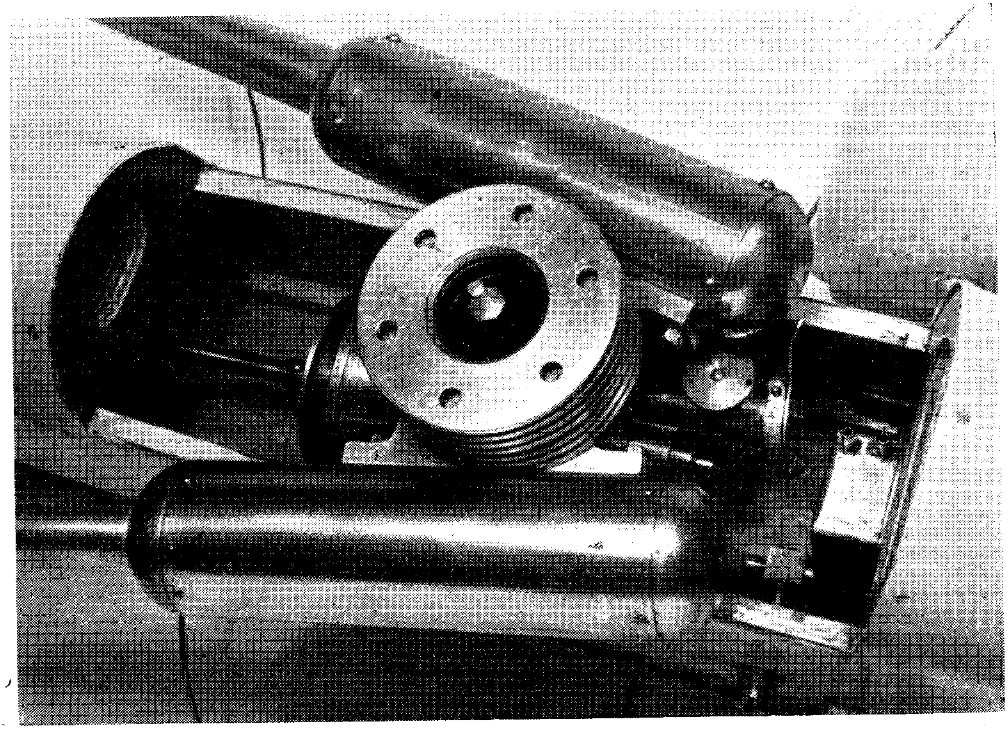
by "Meridian"

*The class "B" Record-holder—*Sparky II*

A RATHER unusual construction of flywheel is adopted, having a dural body with a register turned on the outer edge to locate the brass flywheel rim, which is attached by means of six 4-B.A. countersunk screws spaced at equal intervals of $2\frac{3}{8}$ in. pitch circle diameter. The holes are drilled first in the duralumin body and spotted through to the rim to ensure accurate alignment. Standard ball-races, $\frac{1}{2}$ in. bore × $1\frac{1}{8}$ in. outside diameter, light type without cages, are fitted to the crankshaft.

Crankcase

This is machined from a piece of 2 in. square dural and measures 2 in. × 2 in. × $1\frac{5}{8}$ in. when finished to size. A hole $1\frac{13}{16}$ in. diameter is bored right through to clear the crank disc by 1/32 in. all round. Two pieces of dural, $1\frac{5}{8}$ in. × $\frac{5}{8}$ in. × $\frac{3}{8}$ in. are fixed in the body each side by eight 6-B.A. countersunk screws forming fixing lugs for the engine, and the 4-B.A. fixing bolts that go through the sides of the hull, screw directly into tapped holes in these pieces. The 6-B.A. screws which attach the lugs to the crankcase are filed off flush inside to avoid fouling the working parts. Both the main bearing housing and the front cover are secured to the crankcase by four 4-B.A. steel hexagon bolts.



A birds-eye view of the engine installed in the hull

Rotary Valve and Seating

A dural rotary inlet valve is fitted, $1\frac{3}{4}$ in. diameter × 15/64 in. thick, unbalanced. It is made a press fit on a piece of $\frac{1}{4}$ in. diameter silver-steel forming the shaft, the end of which is drilled down the centre for a short distance so that it can be expanded or swaged over the softer metal as an additional fixing. It is essential

*Continued from page 26, "M.E." January 3, 1952.

that the valve is finally turned between centres after fitting to its shaft, to ensure that the face is exactly 90 deg. to the axis, and runs perfectly truly.

The front crankcase cover forms the seating for the valve on one side, and on the other has a stub flange machined to take the carburettor tube. As much as possible of the surplus metal is removed by end-milling around this flange, and the spindle bearing, to a depth of $\frac{7}{16}$ in.

The front cover embodying the main bearing housing was made from $2\frac{3}{8}$ in. diameter round dural bar, no more metal of square section being available. This accounts for the fixing holes being set on a 2 in. pitch circle diameter, which is rather close to the crankcase bore. The bearing for the valve shaft is sleeved with a cast-iron bush press fitted, projecting on the valve side by 0.0015 in., so that the valve disc is held off its seating by this amount. A steel collar is used to retain the valve shaft on the outer side.

The bore of the carburettor flange is $\frac{1}{2}$ in. continued right through to the valve bosses and flared out to an arc, so that rapid opening and closing of the valve is obtained. At the top of the arc, the inlet port measures $\frac{7}{8}$ in. across. A piece of round duralumin pipe fitted into the stub flange forms the carburettor, which has a throat diameter of 13/32 in. at present, although various sizes have been tried. A " cross-tube " type of jet is employed, consisting of a piece of $\frac{1}{8}$ in. diameter brass tube fitted across the bore of the tube. The cross hole for the jet is drilled with a No. 60 drill and a flat-ended needle of silver-steel, just fitting the bore of the tube, is used to control the fuel orifice. This needle is operated by a knurled head screwed on to the outside of the tube with a $\frac{1}{8}$ in. $\times$ 40 thread, the silver-steel needle being fixed to the end with a touch of silver-solder.

Cylinder

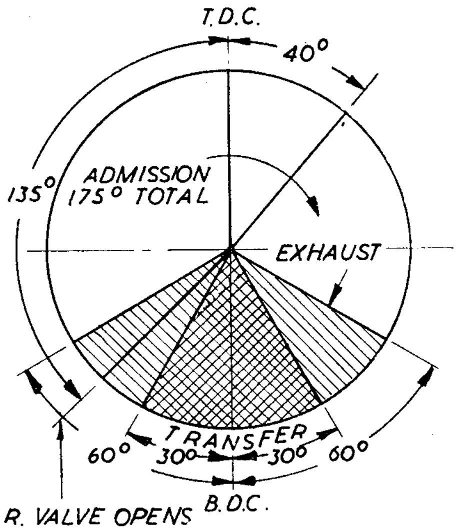
The port arrangements for the cylinder have been arrived at after many experiments, and the dimensions that will be given represent those which have been found to give the best results. It is also important that the bore of the cylinder should be accurate as possible. The liner is turned from a piece of $1\frac{3}{4}$ in. diameter meehanite or cast-iron ; it is 2 in. in length $\times$ $1\frac{1}{8}$ in. finished bore, the outside of the liner being turned to $1\frac{1}{2}$ in. diameter for a length of 1 3/32 in., and the remainder turned to $1\frac{5}{8}$ in. and screwcut 24 t.p.i.

There are ten exhaust ports equally spaced around the cylinder, each port measuring 9/32 in. wide $\times$ 5/32 in. deep. The top of the exhaust porting is 1 in. from the bottom of the cylinder. Below each port there is a transfer channel milled, so that the piston runs on the lands so formed when at the lower part of its stroke. These channels are taken to within 3/64 in. of the bottom of the exhaust port, leaving a 3/64 in. land supporting the two sets of ports.

A home-made milling spindle, mounted on the lathe top slide, was used for machining these channels.

The cylinder, having been finished, including lapping the bore and cutting the exhaust ports, was held in the three-jaw chuck by the inside of the bore with a piece of thin sheet metal interposed between the chuck jaws and the bore to prevent damage.

Indexing was accomplished by means of a 60-tooth change wheel, every sixth tooth being used to give ten stations for the channels. The latter are a full 5/32 in. deep, and several cuts were necessary with a $\frac{1}{4}$-in. end-mill to reach this depth. To ensure free cutting, the end-mill was set at a slight angle, so that the ends of the channels sloped slightly towards the centre of the cylinder bore. During this operation a stop was fixed to the lathe bed so that the depth of the milled channels was uniform ; a slip here would ruin the cylinder, so the tendency of the end-mill to loosen in the milling spindle



Timing diagram of Sparky's engine

chuck should also be watched very carefully. In the photograph of the cylinder published in the issue dated January 3rd, the transfer channels are clearly shown, also the exhaust manifold, which is of dural and a press fit on the lower part of the cylinder liner. It is 1 3/32 in. deep with the exhaust recess turned out $1\frac{13}{16}$ in. diameter $\times$ 13/32 in. wide. The openings to the silencers are $1\frac{3}{4}$ in. wide. Latitude is permissible in the shape of the manifold, and in the 30 c.c. version of this engine, fitted in *Big Sparky*, one large outlet to the rear has been used, the rear portion of the hull being made into a silencer.

A finned belt of cast-iron is screwed on to the threaded portion of the cylinder above the manifold, and four holes, $\frac{3}{16}$ in. diameter, are drilled through the manifold and continued right through the fins. The two upper fins are again bored to $\frac{3}{8}$ in. diameter so that the round fixing-nuts bear on the bottom fin to hold the cylinder unit to the crankcase. Studs screwed 2-B.A. at each end and, $1\frac{3}{4}$ in. long, are employed and the nuts are 13/32 in. long with a screwdriver slot at the upper end.

(*Continued on page 76*)

THE LATHE GROWS UP

by A. D. Stubbs

DARWIN'S *Evolution of the Species* is not quite an apt description and, anyway, he may not be right, although I did see a small boy the other day who gave me furiously to think.

My lathe has evolved to the extent of $\frac{3}{8}$ in. I very nearly made it $\frac{3}{4}$ in. and to do so only means thickening the headstock plate and sole-plate. Jobs like this one always seem to come to me by accident. For a long time I had been vaguely intolerant of the time taken to reset the tailstock after it had been moved for taper turning. Two other disadvantages were, firstly, that when I packed up the top-slide to get a 360 deg. travel, my Armstrong toolholder was too high. Secondly, I could not use that tool-holder in my turret, for the same reason.

However, the straw which broke the camel's back was merely a slack belt, which I could have tightened in five minutes. My countershaft is immediately under the headstock, with a flat belt running through apertures in the bed. The front side of the belt is stayed away from the leadscrew by a jockey pulley which has a $\frac{3}{4}$ in. travel, so giving me quick belt adjustment until the travel is all taken up ; then I cut the belt and start the jockey off again at zero.

One of my idiosyncrasies is that I do not like a belt drive to pull up from the bearings. In a lathe drive this adds to the upward thrust imposed by the tool, so my downward pull is much better for the mandrel bearings.

The bulk of the work is in the tailstock. Fig. 1 shows the finished job. My new cast-iron sole-plate has a fixed gib in front, and a movable one at the rear, capable of being locked on the centre line by a screw clamp. My apologies are offered to Myford for having in part adopted their design. As a matter of fact, I would rather have used another method, but this just seems to be the best way.

My original tailstock locking screw is on the centre line, so my new taper adjusting screw had to go in the same hole. I wanted the clamp screw on the centre line, so the design just grew as I show it. This left me to provide a lateral slide, to enable the tailstock to traverse the soleplate, and a locking device.

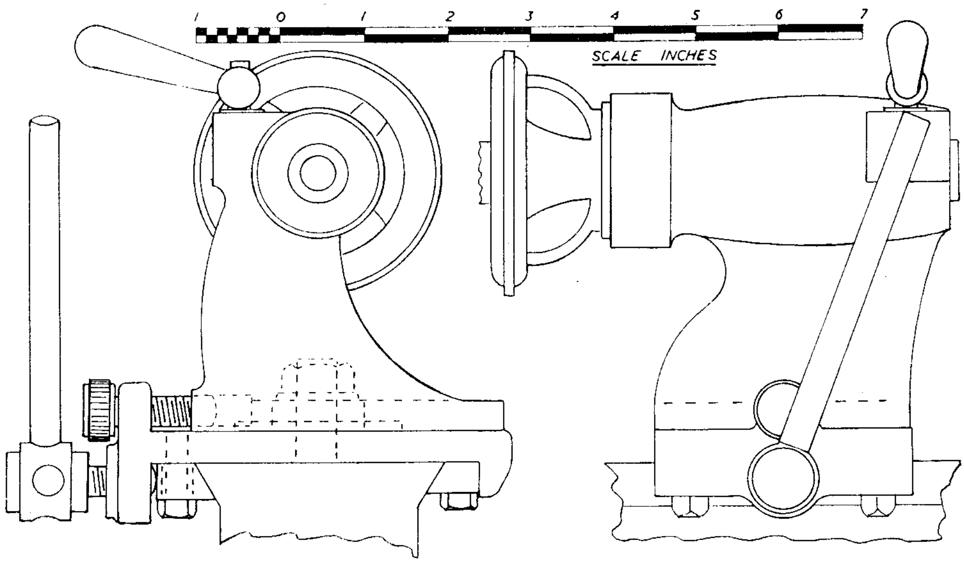


FIG. 1. THE FINISHED TAILSTOCK.

The locking device obviously needed to be on the headstock side, to take care of end thrust, so there it is, in the order of a $\frac{1}{2}$-in. B.S.F. stud, whilst the lateral slide is provided by a $\frac{1}{4}$-in. key. My traverse is $\frac{5}{8}$ in. which is quite useful, in fact, I have never used it right over. It was determined primarily by the existing tapping on the tailstock, where my knurled set-screw goes. A greater range would necessitate lengthening the clamping stud slot in the tailstock base, and lengthening the keyway, neither of which appealed to me.

Fig. 2 shows the soleplate details. The front gib is a separate entity because I could not machine the 30 deg. angle directly on the plate. The first job is, of course, the construction of a pattern. I have met several fellows who have shied like a mule at the suggestion of a casting, but why, I do not know. As far as the pattern is concerned,

you just knock up a replica in any spare wood, bearing in mind that all inaccuracies including pin heads, badly carved curves and so on will all be reproduced faithfully.

Allow for shrinkage to the extent of $\frac{1}{8}$ in. per foot, which is negligible, and for machining, which is not. My soleplate pattern was 31/64 in. thick. The only other snag is to visualise the method of moulding from the pattern. For the uninitiated, perhaps I should explain that the moulder has two four-sided open ended boxes, the one covering the other, and the cover fits the base precisely. In the lower box goes greensand, which is struck level with the box edge, and your pattern is pressed into the sand to a depth determined by any laterally facing boss or curve. A chocolate egg gives you the idea, where the junction of the mould is visible all round. The junction has to be on the greatest diameter, otherwise one half of the egg would not leave the mould.

In Fig. 2, end view, you will see that I show a circular boss thickening the metal for the clamping screw. The lower half of this boss I show without a web, solely to show how impossible it would be to cast from such a pattern except by pushing the $\frac{3}{4}$ in. end of the pattern down into the sand until the centre line of the boss became level with the box top. If the moulder had to do this, he would require the thickness of the pattern to be tapered off, so that the pattern could draw out of the sand on a taper. Such a taper you do not want, because it would have to be machined off.

My web in effect raises the greatest diameter of the boss to the under-side of the plate itself, i.e., the broken line in this end view, so the moulder can either impress the pattern (right way up) in his box until the plate just touches the sand, or he can press it in upside down until the whole of the plate is in the sand up to the under-side level.

The top of the moulder's box now goes on top of the filled box containing the pattern, and sand is rammed round the upstanding part of the pattern until the top box is filled. The moulder can now lift off the top, remove the pattern, probably by driving a spike into it. and there is your desired impression in the sand, How he arranges a runner hole for the molten metal, and another to let the air escape, is one of his worries, so we will leave him with it.

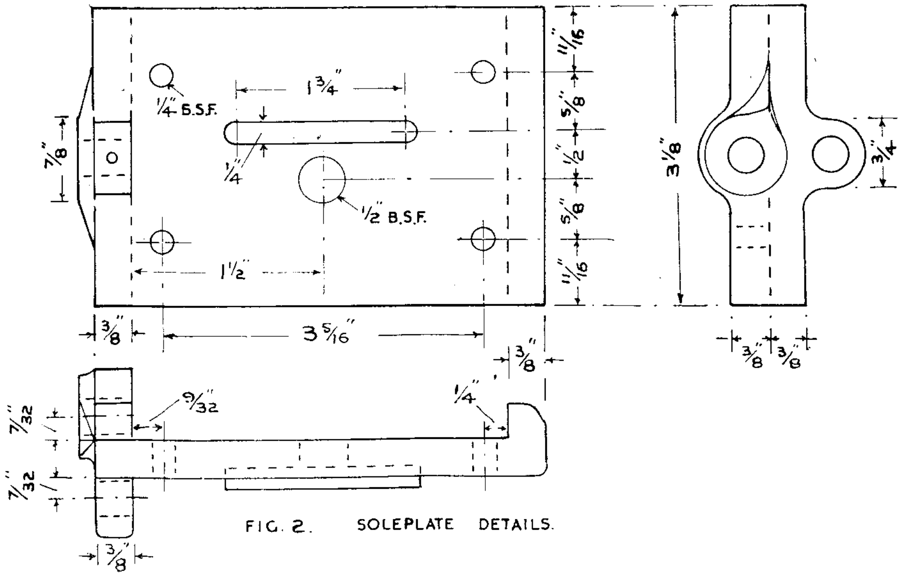


FIG. 2. SOLEPLATE DETAILS.

The side web extensions from the boss greatly increase the strength of the soleplate at what would otherwise be the weakest point.

A second pattern is wanted for the headstock plate, unless you cut this from plate steel.

Having acquired my casting from the nearest ironfounder, some ten miles distant, I drilled and tapped the four $\frac{1}{4}$-in. B.S.F. holes, and used these holes for set-screws, carrying the plate on the milling slide on flat steel strips through the vee slots. This enabled me to end mill the whole of the under-side, and side mill the two internal ends, in the one setting.

Reversal of the plate on the milling slide now enabled me to mill the whole of the upper surface until the plate thickness was 0.375 in. precisely. In reversing the plate, especial care must be taken to ensure not only that the plate and milling slide surfaces are perfectly clean, but that the machined under-side of the gib strip is truly vertical.

Now mill the $\frac{1}{4}$-in. slot, $\frac{1}{8}$ in. deep, for the keyway, then turn the milling slide 90 deg., which enables the bosses to be milled, drilled and tapped. The central $\frac{1}{2}$-in. B.S.F. hole was drilled and tapped with the soleplate distanced from the milling slide.

I now had the tailstock to operate upon. Fig. 3

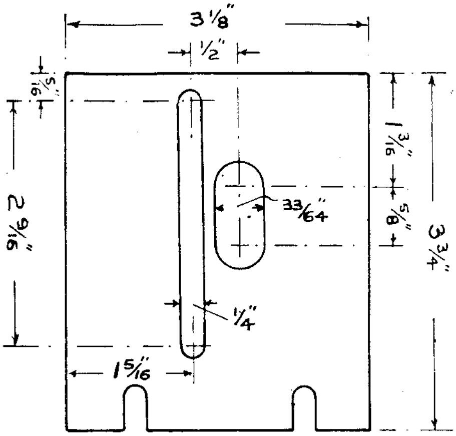


FIG. 3. TAILSTOCK BASE.

is in the under-view, the slots in front being already present. This end, if desired, could be cut off. Especial care is necessary to ensure that the $\frac{1}{4}$ in. keyway, again $\frac{1}{8}$ in. deep, is at 90 deg. to the lathe centre line, but having the full length of the barrel to check by, this presents no difficulty. My nearest reamer for the clamping slot was $\frac{1}{2}$ in. but the milling slide movement

this, and reduce the end of a grub-screw to register in the screw groove. However, by that time I had all the components assembled ready to go on the lathe, and could not wait, so I dropped in an end of silver-steel, which has lived in the hole ever since. It is quite happy, and so am I.

And up on the lathe bed went the soleplate, with the tailstock a short head behind. I checked it for alignment on the barrel, fully extended, and found it to be about 0.0025 in. out on the barrel length. In an endeavour to correct this, I took down the front gib, and hand filed out a central recess about 1/64 in. deep on the 30 deg. angle face, length $1\frac{1}{4}$ in., with the intention of honing down the offending end.

Before actually touching the contact ends, it dawned on me that the saddle traverse had been unusually tight. After dismantling, cleaning down and reassembling the saddle, I put back the gib, compressing it from corner to corner in the vice and tightening the set-screws with the gib under pressure, and found the error had gone the other way to about 0.0008 in. as nearly as I could measure it, so after a little honing I called it a day.

For the headstock plate, Fig. 7, I took a rubbing from the headstock itself. The casting does not contact across my $\frac{1}{2}$ in. dimensioned end, so only an elongated U-plate is really required.

Mine is a complete rectangle partly to minimise casting distortion, but principally to enable

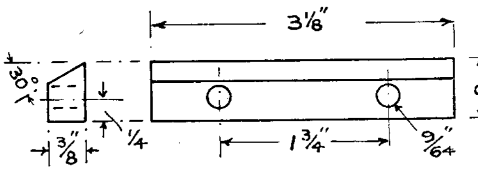


FIG. 4. FRONT GIB.

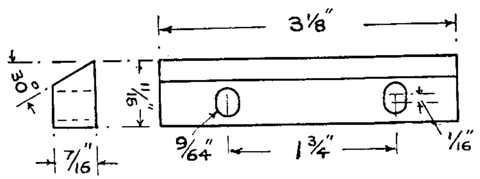


FIG. 5. REAR GIB.

soon made the slot wide enough to accept the stud.

For the key, out of commercial key steel, I cut a piece about 4 in. long, held at at the extreme end, and milled one face and two sides at the same setting, using the soleplate as a "go" gauge. The thickness was then milled to .246 in. and the ends cut and filed half-round.

Fig. 4 came straight from the original tailstock assembly, but the rear gib, Fig. 5, I had to make. As a matter of fact, I forgot to get a piece of flat steel for this, and to avoid wasting a perfectly good wet afternoon I milled it out of $\frac{7}{8}$ in. diameter black steel, and the 9/64 in. holes were draw-filed $\frac{1}{16}$ in. out of centre.

Fig. 6 speaks for itself, except that the four barring holes in the clamping screw are all screwed $\frac{3}{8}$ in. enabling the lever to be set in either. The $\frac{5}{16}$ in. length of thread on the $\frac{1}{2}$-in. stud ensures that the stud does not foul the lathe bed.

The 3/32 in. groove on the taper adjusting screw is my own patent. In Fig. 2, plan, you will see that the boss is drilled here. My intention was to tap

me to hold it on the faceplate by three set-screws, so the holes were drilled and tapped $\frac{1}{4}$ in. Whitworth.

One face was turned to clean metal in one cut, with a second light cut to give a good surface, after which my flexible grinder went into operation.

Repetition on the other side, and grinding to 0.002 in. over the $\frac{3}{8}$ in. thickness brought me to the stage when I decided to check with the tailstock height. This meant a probable resetting, but

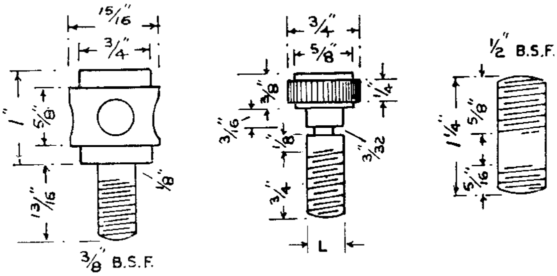


FIG. 6. SCREWING DETAILS.

it was as well that I did, for another two thous. off would have put me undersize.

Thinking it over since, I have come to the conclusion that the tailstock soleplate thickness is plus two films of oil, whereas I put up the headstock dry.

Valve-grinding paste plus about half a hundredweight of elbow-grease brought the job just about right. The ½ in. end of the plate I cut out, and it became a useful packing piece, because I milled the remaining two sides one day. The two ¼-in. Whitworth holes were, of course, drilled out to 17/64 in. after the plate had been machined.

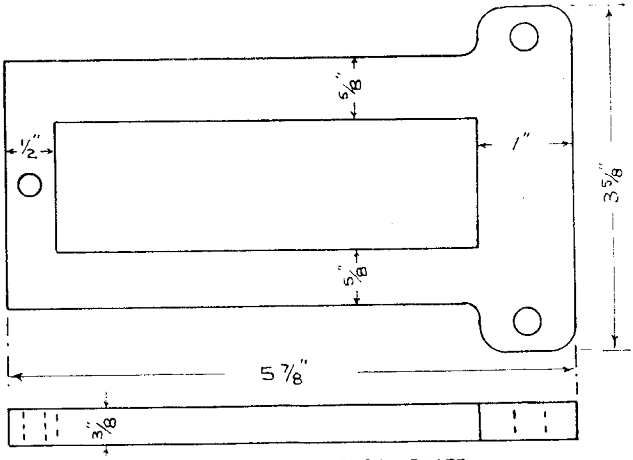


FIG. 7. HEADSTOCK PLATE.

So far I have only once needed the extra ⅜ in. that I nearly adopted, and that was when boring out a tit-nesting box, using a log from the fuel store. We had a couple of wrens in residence last year, and they have not complained, as far as we know, about their home being bored slightly off the centre of the wood grain.

Model Power Boat News

(*Continued from page 72*)

Duralumin finning is used at the upper end of the cylinder, also screwed on to the cylinder liner and having an internal lip which bears on the contra-piston to hold it in position. The latter is of cast-iron lapped to a push fit in the bore, having a depth of ⅜ in. with the lower end internally bevelled, and centre-drilled and tapped to take a standard glow-plug ¼ in. × 32 t.p.i.

Piston and Connecting-rod

A composite piston is employed, having a flat top, and the depth is ¾ in., the outer shell having walls only 1/32 in. thick, the crown being left 0.050 in. thick and a lip left at the bottom to stiffen the skirt. Meehanite has been found the most satisfactory material for the piston. It is made a very close fit, the finish on both the piston and the cylinder being achieved by the usual lapping methods often described in THE MODEL ENGINEER. A yoke of dural is fitted inside the piston, having bosses for the gudgeon-pin, which is ¼ in. diameter high tensile steel drilled through the centre 5/32 in. diameter for lightness.

A dural connecting-rod is fitted, the main section being ½ in. × 5/32 in., except at the big and little ends, where it is 5/16 in. thick.

A floating bush of cast-bronze, 0.420 in. diameter on the outside, is fitted to the big-end, the inner diameter being made a running fit on the crankpin. The rod is assembled with the yoke and gudgeon-pin before riveting to the piston by four 3/32 in. rivets, those used in the original piston being common iron rivets which served quite well. The rivets are headed by means of a concave-ended punch which leaves a neat rounded snap head on the piston crown.

Fuels

Excellent results have been obtained using a standard methanol-castor oil mixture, but all the record performances have been attained with the addition of about 10 per cent. nitro-methane. Greater proportions of nitro-methane than this do not seem to give much more speed. The proportions are : castor oil, 25 per cent. ; methanol, 65 per cent. ; nitro-methane, 10 per cent.

The whole of the machining of this engine was done on a pre-war Gamage lathe of 3 in. centres, the original price being about £6, a rather interesting point when present-day prices are considered. Obviously a light type of lathe such as this, requires intelligent handllng, but there are many expedients and tricks of the trade that can be used to obtain the precision fits necessary to produce a successful racing engine.

[Readers have expressed approval of these articles on one of the most ingenious and successful model speed boats and have asked for further articles on other well-known boats in the various classes, also information on the design of essential accessories, such as tethering gear, propellers, shaft fittings, etc. This matter has been referred to our contributor "Meridian," who will we hope be able to satisfy these requirements in future articles.—ED., "M.E."]

*A MODEL GRAND PRIX RACING CAR

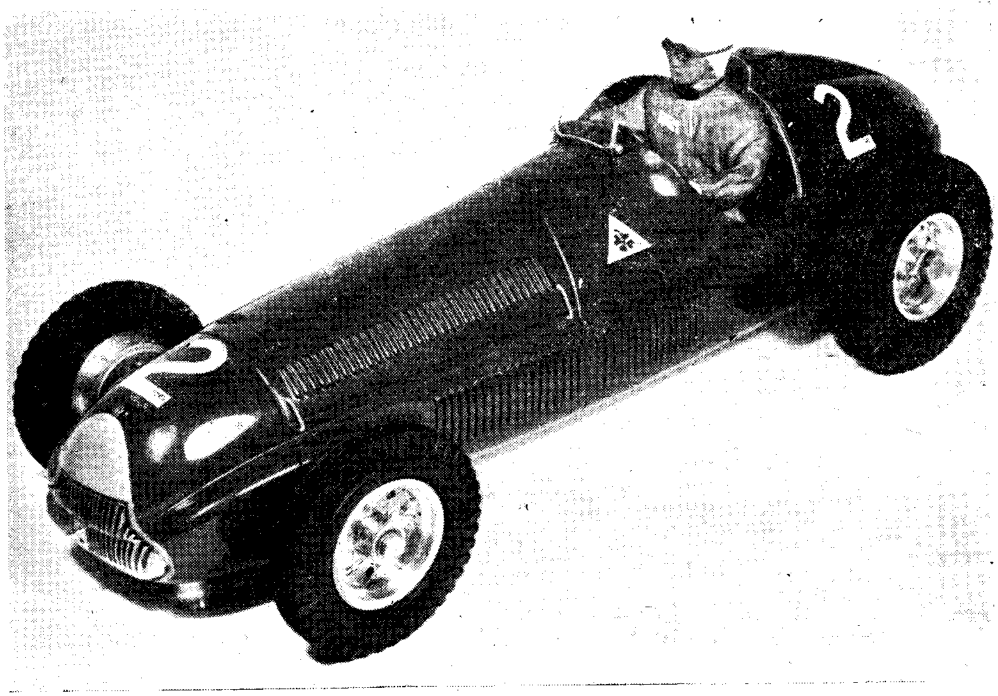
Rex Hays describes the construction of a miniature Alfa Romeo, Type 158, to $\frac{1}{12}$th scale

FROM the engine we travel along the fuel line to the fuel tank, which is of large capacity, and fitted beneath the bonnet. This was formed in brass with copper straps soldered to it for bolting down on to the chassis. The illustration (Fig. 10) shows a sketch of this tank and also shows the deep indentation in the top which is to allow the steering column to pass from the cockpit to the track-rod, at the right angle. The fuel filler pipe was brought back from the tank into the cockpit to facilitate easy and quick " Pit Stops " for re-fueling. Moving back to the cockpit area an instrument panel bracket was filed out of aluminium (see Fig. 11). It was drilled to take the steering column and bolted to the chassis. The steering wheel and column were formed in brass, the assembly being dull plated.

The instrument panel was designed with the bodywork in place, and fitted so that it blended well with the body in position, but did not interfere with its easy removal—it was made in polished aluminium. The holes for the instruments were filed out, and a sheet of aluminium cellulosed black fitted behind, this black facing being backed by a further piece of this gauge aluminium, the whole " sandwich " being bolted to the instrument panel bracket.

Travelling down the steering column we arrive at the front suspension.

Much earlier on we reached the point at which the trailing links of the suspension emerge from the bodywork. The point must be exact, or else the whole front end aspect of the car will not be correct or convincing, and, moreover, the wheel base will be wrong. In consequence it became obvious that some " bending " would have to occur within the body shell if the trailing arms were to be positioned correctly externally.



Near side view

Four arms were turned up on the lathe, each with a ball at the tapered end, this ball being filed flat top and bottom and drilled.

Next, the brake-drum backplates were turned up, the stub axles brazed to the centres, and a piece of tube brazed vertically to the inside to take the trailing links (Fig. 12). These trailing

*Continued from page 6, " M.E.," January 3, 1952.

links were then bolted to the backplate so that they swivelled (Fig. 13). Then the steering arms were bolted and soldered to the backplate, these arms being formed in brass. Now the delicate bending operations on the trailing arms took place. The angle was arrived at by experiment in conjunction with repeated fitting of the bodywork. The correct degree of bend having been achieved, a distance-piece of brass tube was

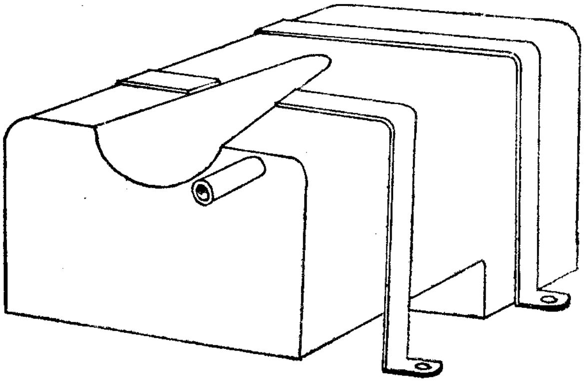


Fig. 10

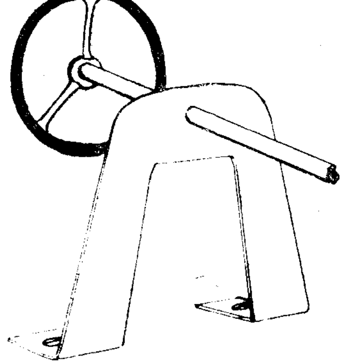


Fig. 11

soldered between the inner ends of the arms, the arms drilled, and a steel bolt through the whole assembly fixed it to the chassis, a bridge-piece being bolted between the two sets of trailing links just to steady the assembly; not that it was really necessary, as the units were tailor made to the body openings and were, with the bodywork in position, as firm as a rock. The track-rod was then formed and bolted to the two steering

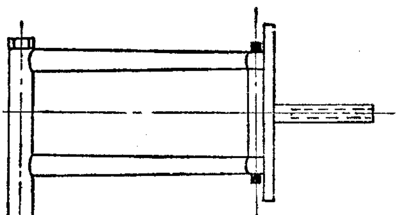


Fig. 13

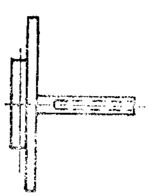


Fig. 12

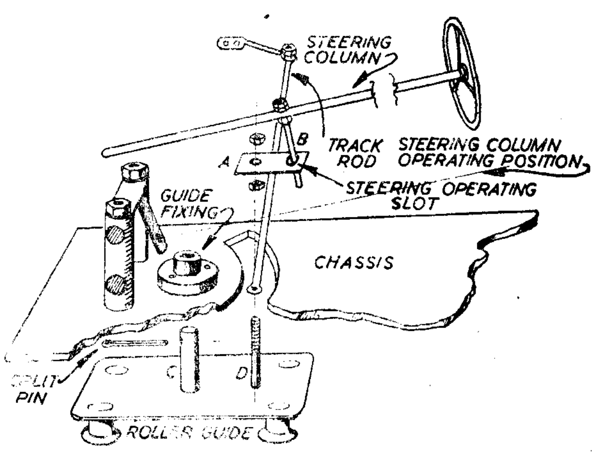


Fig. 14

arms on the backplates. The track-rod was flattened slightly in the centre, and a plate soldered to it (Fig. 14A). Through an elongated hole in the rear end of this plate a small rod drops vertically from the steering column which operates the steering "B," when the track-rod is moved through the steering of the wheels. The wheels in turn are moved by the swivelling movement of the rollered guide, which is situated under the car between the track of the front wheels. The guide is attached to the chassis by a bushed vertical central fixing "C." A further vertical shaft "D" fixed to the guide plate at its rear end, and coming up through a slot in the chassis plate works in a hole drilled in the forward end of the plate already referred to, the rear end of which operates the steering.

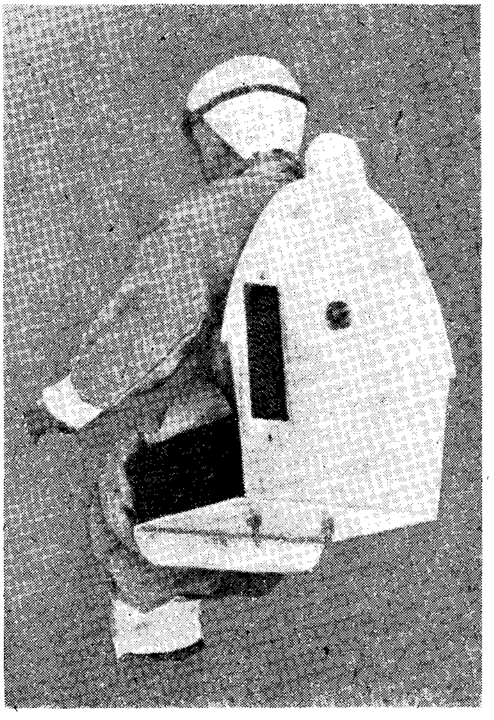
In operation the car moves along a track, the wheels being astride a central rail, the rollered guide keeping the car directionally correct. As the car corners, the guide working in much the same manner as the bogie wheels of a locomotive, turns to the radius of the bend, taking with it the wheels of the car; through the wheels, the track-rod movement is used to operate the steering column. The steering column movement turns the steering wheel, which in turn moves the driver's arms through his "hands" which are clipped to it. Thus we get an astonishingly realistic moving picture of the driver, whose

head, shoulders and trunk are carved in wood, is clothed in the well-known Pirelli overalls of the Alfa team, and is fixed firmly in the cockpit, so that he appears to maintain the unruffled calm and driving characteristics practised by the leading Grand Prix racing drivers. Only his arms to the shoulders move with the wheel.

Travelling fast into a corner, the tail of the car slides appreciably, so much so, in fact, that

The only noticeable external features omitted are the bonnet removal handles, which are two very small "T" shaped plated handles situated on top of the bonnet. They were left out because sooner or later a cleaning rag or something similar would get caught up in them and rip them off, or worse, drag the model off a table or out of the hand.

I think that the powered scale model must be



The driver should be as realistic as the car. Note method of attachment to seat, also rectangular gap for air inlet to carburettor

a further rollered guide situated towards the tail, just beneath the cockpit, and which "trails" on the straights, comes into operation on the fast corners, stopping the tail overrunning the rail. These rollered guides were constructed in sheet steel (18-gauge). The front guide has four rollers, which run freely on vertical shafts brazed to the brass plate. The trailing guide has only two rollers, and is fixed to the chassis by a vertical shaft bushed at its front end.

Finally, the driver, which I have just referred to, is screwed to his seat, which is, in turn, screwed to the removable bulkhead, at the rear of the cockpit. This bulkhead has two deep wide slots filed in it on either side of the driver. It was found that the engine could not get sufficient air to run satisfactorily unless this was done. In addition, the underside of the tail was louvred liberally. The real car has louvres located here, a detail which is not generally realised, and which come in very handy, helping the exhaust gases to escape readily on the model.

"comfortably functional," by that I mean that very delicate detail must either be left out or ingenious means found to represent it in a manner which is convincingly very strong, and not likely to be an embarrassment to the normal handling and cleaning of the model. For example, the Alfa Romeo bonnet is held down by four spring-type bonnet clips ; these clips, if represented in great detail, will quite obviously come to grief the first time a cleaning cloth is brought anywhere near them, consequently these fastenings were represented by four long 12-B.A. screws with the heads severed, annealed so that they would bend at right-angles each end, and press into the bodywork. They were dull plated and give a very convincing representation of what they are meant to be and, at the same time, cannot become damaged or detached.

The right atmosphere, and a good effect, is gained by including the word PIRELLI, written in the correct characters on the driver's overalls. Likewise, a spare pair of goggles round the driver's

neck lend an authentic something to the general appearance.

The method of starting up this powered model, for the benefit of those new to this type of thing, is as follows :

During the describing of the clutch I mentioned the pulley wheel, and it is through the rapid revolving of this pulley wheel that the engine starts.

First, of course, the fuel tank is filled. The fuel used while testing was a castor-based mixture with amyl nitrate and Redex additives for running in, which seemed to give very good results. The starter we used was a Picador rubber sanding disc. These discs are constructed to take sandpaper, or emery or polishing pads, and are made to fit the chuck of an ordinary electric drill, and when used without abrasive or polishing attachments fit beautifully into the pulley wheel. As this rubber disc is 5 in. across, there is plenty of room for operating it in comfort, without damage to the bodywork.

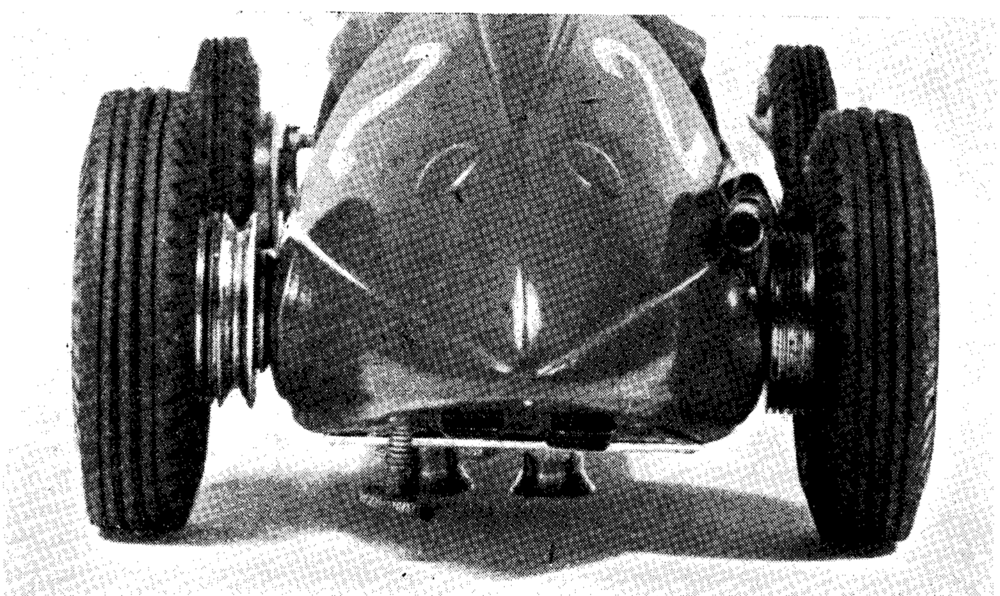
The drill complete with rubber starting disc is then applied to the pulley wheel, switched on, and, as the engine is turned over rapidly, the character in charge of the compression screw slowly tightens it down until the correct degree of compression is reached, and away she goes !

These engines, at all events when new, are very sensitive to compression and throttle adjustments, but, unless they are over-choked, start quite easily once the correct settings have been arrived at.

Finally, we come to the testing of the model on our indoor test track, which is purposely designed to incorporate bends, and a 1 in 14 upward gradient. First, we ran the chassis for what must have been " miles " waiting for weaknesses to become apparent before we entrusted our precious bodywork to violent action. Nothing came adrift during this test running—in fact, everything, including the tyres, behaved perfectly. We then fitted the bodywork and driver, and at once found that starting was difficult, and when started, the engine ran uncertainly and stalled easily. The trouble, which I have already referred to, was lack of air, the bulkhead at the back of the cockpit effectively sealing the engine. It was then that two deep slots were filed in this bulkhead on either side of the driver. This cured the air starvation, and for the first time the complete Alfa Romeo motored in a big way, the exhaust noise sounding rather like the real thing on the " opposite side of the circuit " at about 170 m.p.h. It was quite a thrill, and our testing continued for a long time, so fascinated were we by the spectacle of car and driver in action.

That, I think, completes a design for a scale model adapted to conform to the requirements of a rail circuit. Like the development of all new ideas, we shall, no doubt, find that we are able to improve upon this or that, but I do sincerely hope that any chassis development will not be permitted by any governing body to interfere with external realism in even the smallest exaggeration of bulge or outline.

I believe that the spectacle of really realistic and accurate scale models, preferably of teams of cars painted in their international racing colours, their drivers working at the wheel and clothed in the correct style and colour of overalls, could not only borrow some of the character and attraction of their grown-up brothers, but actually rival them as a spectacle to watch, especially if the scene could be set complete with



Rear view, showing louvres and needle-valve control. Note small flywheel and original backplate

pits, spare wheels, personnel, bridges, bunting and all the almost medieval jousting atmosphere, which somehow pervades the great motor racing circuits.

As this circuit motor racing is a new form of miniature pastime, sport or hobby, I hope that it won't be looked upon as "kids' stuff" and "playing with toy motors." I, personally, have a great regard and love of all things in miniature, and would not dream of offending lovers of model railway operation by referring to these locomotives and rolling stock as toy trains, as I am aware that the mechanics of a railway lay-out are deeply interesting and represent one of the most absorbing of all hobbies. And may I suggest that those who might have preferred these pages to have been about locomotives, for instance, might one day have a motoring circuit running adjacent to their railway system, and enjoy the sport of the one and the grand hobby of the other, both at the same time.

Now for the last time returning to the full scale order of things, I recall that Brooklands, one time home of British motor racing, had a railway straight where trains and racing cars raced happily side by side, and more than once I have seen "crew" and passengers waving to the drivers on the track who somewhat naturally were "too busy" to return the salute—remember it?

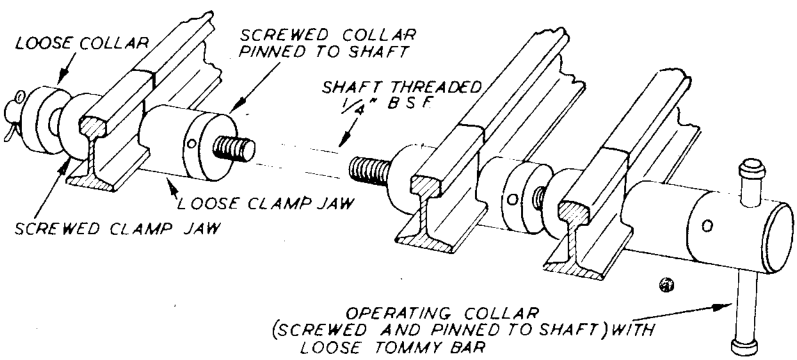
May I hope that this new development of model motoring will gain for itself a place as permanent and absorbing as the other forms of miniature sport and activity, and become as thrilling and dignified as the real thing.

MIND THE GAP!

by W. H. Pledger

WHEN the new continuous locomotive track, constructed by members of Vickers Live Steam Locomotive Section of the Model Club at Byfleet, was planned, it was found desirable to leave a place where the groundsman could get his grass-mowing machine in to the centre, in order to keep the enclosed grass from resembling a wilderness.

A section of track was made which could be lifted out, but owing to allowances that have to be made for expansion gaps in the rails when in running position, the riding over the joints did not inspire confidence in the driver and passengers.



Something had to be done about it and the rail clamp which I have made from stainless-steel has cured the trouble, giving smooth running at all speeds. We are using these clamps at both ends of the lifting section and also at the turntable in the main circuit, where rolling stock is turned into the lay-by sidings and engine shed.

The drawing is self-explanatory and I thought perhaps that other clubs using the flat bottom rail section,—ours, by the way, are the light alloy rails supplied by Fenlowe Products of Weybridge (usual disclaimer)—may find the idea of some interest. I think that the usual fixing bolts that are used at gaps in the rails are liable to cause trouble after a good deal of use, but the rail clamp illustrated is self adjusting for wear and positively locks the track in alignment.

Square section could have been used for the clamp-pieces but the only reason I used round bar of $\frac{3}{4}$ in. diameter, was that it is more readily obtainable. Stainless-steel should be used if the clamps are to remain in position during the time the track is in operation.

When erecting, care should be taken to "time" the screwed collars so that they bear with equal force on the base of the rail in order to preserve the correct gauges, in this case $3\frac{1}{2}$ in. and 5 in.

The $\frac{1}{4}$ in. wide collars were drilled for pins while the complete clamp was fitted to a section of made up track.

One final point, the clamp-pieces should be made no longer than $\frac{3}{8}$ in. to give sufficient clearance between the two closer rails when the clamp is slackened off.

*A Universal Dividing Head, PLUS

by A. R. Turpin

THE next circle of holes to be drilled is that of 20 divisions using every other hole in the strip, so cut off eight holes leaving 42.

Remove the " L " plate, swing the turning tool round in the back toolpost, and turn down the disc to size, if necessary knock out the arbor and remove the division plate. Don't forget to turn the shallow groove in the edge of the disc. Cut the necessary recess and replace the locating plate, and the shortened perforated strip.

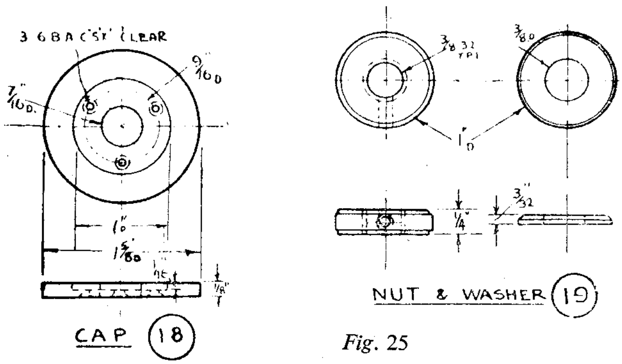


Fig. 25

As shown on the drawing the 20-circle of holes is placed 0.8 in. in from the 49-circle, so proceed as follows : Replace the division plate, push the arbor nearly home, but not quite, place the detent in the second hole below the locating peg—we are using every other hole this time—and enter the point of the drill in the first hole drilled in the 49-circle, and then tap the arbor home. Rack back the drill, and feed the cross-slide in 0.8 in., or eight turns of the feedscrew handle, the index should read as before noted. The 20-division circle may now be drilled, and after this the remainder in the order, 49, 20, 39, 18, 17, 33, 16, 15, 27, but there are a number of points to remember : that the circles are drilled in their correct order as shown on the drawing (this will make no difference to the working of the head, but the appearance of the finished plate will be improved) ; that the strip should have twice the number of holes plus two, for those divisions below 27, and that only every alternate holes are used for these.

Regarding the groove cut in the periphery of the disc to give clearance to the detent pin, if the end of the turning tool is shaped as seen in the photograph, the groove may be cut by feeding the tool straight in. By the way, when commencing to drill each circle of holes, the division plate should always be positioned by placing the drill in the first hole of the 49-circle, otherwise a cumulative error may arise.

Having completed the dividing, the plate is removed from the arbor, and the number of each circle stamped with figure punches as shown in the drawing, the plate is then remounted on the arbor, and rotated in the lathe so that the burrs on the holes and figures may be removed, back and front, by application of small oilstone, and plenty of oil.

Now mount the plate on the spigot of the spindle bearing, and drill the 6 B.A. tapping holes right through into the bracket with the plate positioned so that the starting line of the circles is upright.

Tap the holes in the bracket, open up the holes to clearance size in the plate, and countersink them so that the head of the screw is slightly below the surface.

The next thing to do is to get the worm and wheel working, because we shall need to use it ;

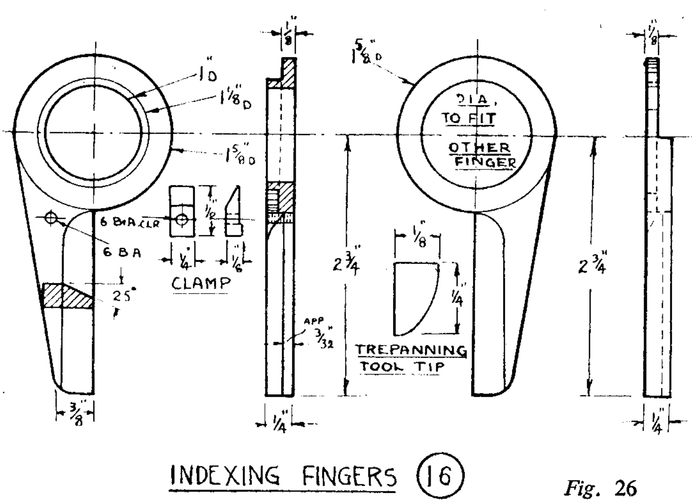
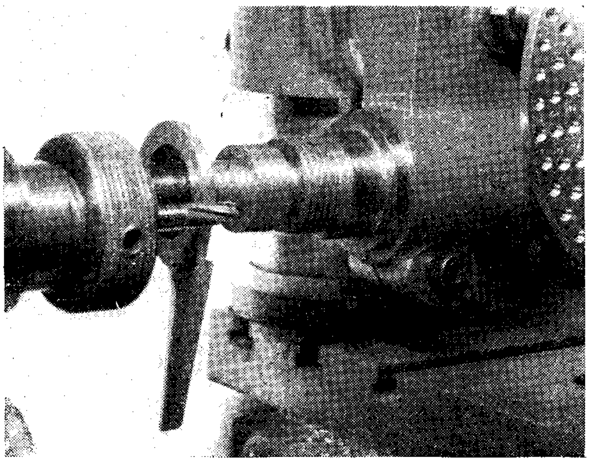


Fig. 26

*Continued from page 46, "*M.E.*," *January* 10, 1952.



Photograph No. 27. Circular milling the index finger

so we will skip a few items and move on to the cap.

The Cap (18)

This is shown in Fig. 25, and it is screwed to the end of the spigot on the spindle bearing bracket by three 6 B.A. countersunk screws, and its purpose is to retain a spring washer which gives frictional control of the index fingers. It can be turned from a piece of bar, and after cutting the recess and drilling the centre hole, it is parted off.

Mark out the three 6 B.A. holes, and place the cap on the end of the spigot, drill one tapping hole right through into this; tap the hole, drill and countersink the hole in the cap, and fix with a screw which will hold it whilst the other two holes are dealt with in a like manner.

The Spring Washer

This is made from 16 s.w.g. piano wire, heated to cherry red and wound round a suitable mandrel, retempering may not be found necessary, grind flats on either side by rubbing on oilstone, using a block of wood to keep it flat.

The Bearing Adjustment Nut and Washer (19)

The washer and nut (Fig. 25) are both machined from a piece of 1 in. diameter B.M.S. bar, but turn the nut first so that you will not waste metal, this having the smaller hole which should be drilled $\frac{5}{16}$ in. Knurl and cut the shoulder each side of the knurl, and then part off, leaving sufficient metal for facing the parted-off side. Grip in the three-jaw with a strip of thin brass to protect the knurled edge, placing a piece of packing behind the nut so that the front face is truly parallel to the chuck face. Open out the centre hole with an "R" size drill and machine cut the $\frac{3}{8}$ in. × 32 t.p.i. thread; then face and mark the side so that you know which is truly at right-angles to the thread.

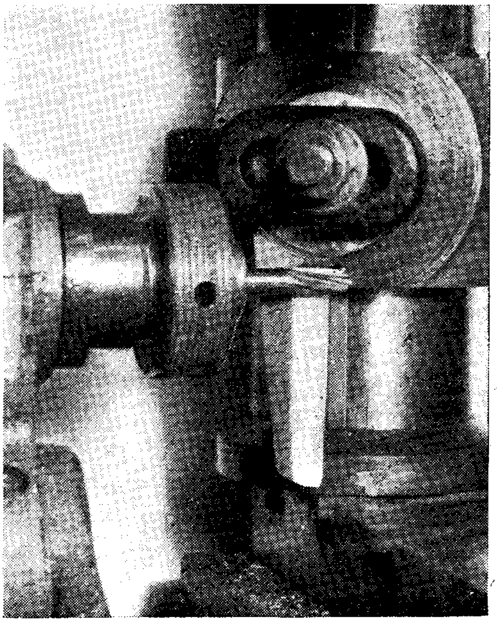
Remove from the chuck and drill and tap the 4 B.A. hole for the locking set-screw, and brass pad.

Place the washer on the worm spindle and screw on the adjusting nut until all play and end-play is taken up. It may be found at this point that the spindle tightens up slightly at various points as the worm wheel is revolved, in which case put a brass protecting sleeve on the end of the spindle and grip in the three-jaw; the mandrel bearing having been removed from the carriage. Bring up the back centre to the centre hole already drilled in the other end of the spindle, allowing the mandrel bearing to rest on the bed of the lathe. Apply oil to the mandrel bearing, and to the worm and wheel, and run the lathe for a couple of hours to bed the worm and wheel in; then, if necessary, tighten the adjusting nut so that the wheel rotates freely without backlash or end-play.

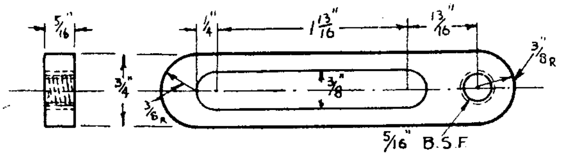
The next thing to do is to make a temporary handle for the spindle so that we may rotate the mandrel, and this can be done by taking a short length of, say, $\frac{1}{2}$ in. × $\frac{1}{4}$ in. bar, 3 in. long, drilling and tapping a $\frac{5}{16}$-in. B.S.F. hole near one end of it, screwing this on the end of the spindle, and then locking it with a nut.

The Indexing Fingers (16)

Fig. 26 shows the shape of these, and they can be machined from castings, or cut from $\frac{1}{4}$ in. thick brass plate, and I think the latter is the easiest in the long run if only one set is to be made. So mark out the outline of them on the plate and cut them out with a hacksaw, and roughly trim



Photograph No. 28. Milling the bevel on the index finger

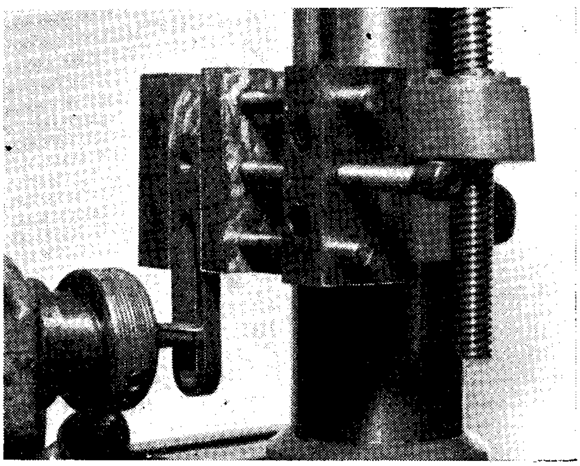


DETENT SUPPORT BAR. (20)

Fig. 27

up with a file. Drill a $\frac{3}{8}$-in. hole through the circular portion, and mount on our morse taper arbor, which in turn, should be inserted into the dividing head mandrel.

Mount the head on the cross-slide, and a $\frac{1}{4}$-in. end-mill in the collet chuck of the lathe, and adjust the pillar slide, and the cross-slide feed-screws to bring the edge of the circular portion against the side of the end-mill, as seen in photograph No. 27 ; start up the lathe and then rotate



Photograph No. 29. Milling the slot in the detent support bar

the finger by revolving the temporary handle fitted to the spindle, thus circular milling the edge ; but remember that the direction of rotation must be against the cut, otherwise the end-mill will snatch, and jam the work. Take a few thous. off at a time until the diameter of the boss is that required.

The finger is now moved by adjustment of the feedscrews of the pillar, cross-slide, and the worm, so that the cut travels along the edges of the finger. Finally, the head is turned to bring the finger at an angle of 25 deg. to the cutter, and the bevel is milled, photograph No. 28. It should be noted that the diameter of both circular portion of the two fingers must be the same.

The left-hand finger in the drawing should now be mounted in the three-jaw with a piece of packing behind it so that it is dead square with the chuck face, and then the centre 1 in. diameter hole can be bored a nice fit on the spindle bracket spigot.

Grind up a trepanning tool—an enlarged drawing of it is shown in Fig. 26, and turn the recess which houses the other finger ; make certain that the diameter is large enough to house it before removing from the chuck.

Next, drill and tap the 6 B.A. hole for the clamp, the exact position of this hole is not important, but it should be central on the flat portion of the finger and about $\frac{3}{16}$ in. from the edge of the turned recess and the clamp projecting $\frac{1}{16}$ in. on to the other finger boss. The clamp itself can be filed up from a piece of $\frac{1}{4}$ in. $\times$ $\frac{1}{8}$ in. steel.

The second finger is now mounted in the same way in the chuck, the circular portion reduced in thickness to $\frac{1}{16}$ in. and the centre bored out a nice fit on the rim of the other.

Finish all surfaces with an oilstone slip.

The Detent Support Bar (20)

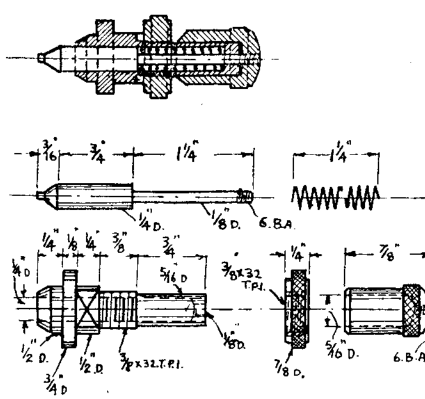
This is cut from a length of $\frac{3}{4}$ in. $\times$ $\frac{5}{16}$ in. B.M.S. bar. Mark out the slot, and tapped hole. (See Fig. 27.)

Drill and tap the $\frac{5}{16}$ in. B.S.F. hole and then drill a series of $\frac{5}{16}$ in. holes touching, and in line and file these to form a slot, but do not make it quite the finished width. Now mount the bar in the machine vice on the pillar slide and mill out the slot to size with a $\frac{5}{16}$ in. end-mill as shown in photograph No. 29. I find this method of rough cutting the slot first quicker than milling the slot completely, and it is less strain on the cutter, and not half so tedious.

The slot completed, mount the bar on the Morse taper arbor—a new stud will have to be fitted—and mill the round ends in the same way as the circular portions of the fingers were done.

Rub down on an oilstone to remove all burrs, and impart a good velvet finish.

The acorn nut can be purchased, and the spindle cut down if necessary



DETENT. (21)

Fig. 28

so that it may be screwed down tight on to the bar to lock it.

The Detent (21)

Fig. 28 shows this in detail. The pin is turned from a length of silver-steel, and the point formed to the same shape and dimensions as the centre drill used to drill the holes in the division plate. Chuck the pointed end in a collet chuck, or to run truly in the four-jaw, centre the end with a B.S.1 drill and bring up the back centre to support it, then reduce the diameter to the size shown. Reduce the end to 0.11 in. diameter for a length of $\frac{3}{16}$ in. and screw 6 B.A. using the tailstock die-holder.

The body of the detent is machined from $\frac{3}{4}$-in. diameter B.M.S. rod. Chuck in the three-jaw, face and centre the end with a B.S.1 centre drill, taking the body of the drill well in, and then drill right through with a sharp and accurately ground $\frac{1}{8}$-in. drill; it is important that the hole is drilled truly axial. Open out this hole with a "D" size drill to a depth of $1\frac{5}{8}$ in. and then reamer $\frac{1}{4}$ in. diameter; this will leave the end of the hole tapered, but this is of no account provided the outside diameter of the detent spring is slightly below this dimension.

Turn the various diameters as shown in the drawing, and screw cut the $\frac{3}{8}$-in. thread, or use a die held in the tailstock holder.

Use the filing rest to cut the flats on the $\frac{1}{2}$ in. diameter portion, so that the body is a nice sliding fit in the support bar slot.

To save rechucking the portion behind the flange, it may be reduced with a parting tool, and the chamfer turned with a "V" tool held in the back toolpost, and then parted off to length.

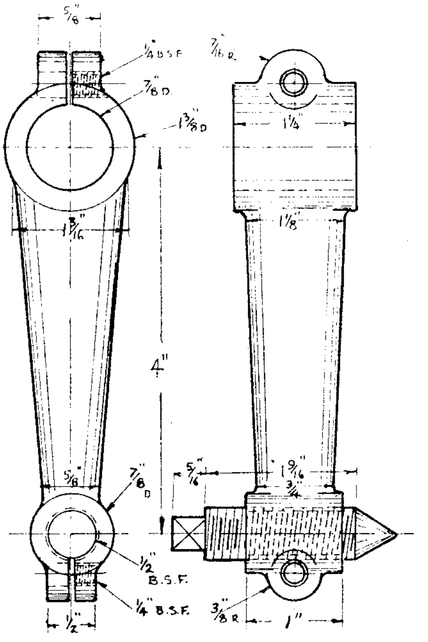
Chuck a short length of $\frac{7}{8}$ in. mild-steel rod for the circular nut; skim, and then knurl; drill and tap $\frac{3}{8}$ in. $\times$ 32 t.p.i. holding the tap in the tailstock, or if you have the train already set up, screw cut it; cut the shoulders just below the depth of the knurling with a parting tool, and part off.

The cap may be of brass, and is a straightforward turning job, except that care should be taken to see that the tapped hole in the end is concentric with the $\frac{5}{16}$-in. bore. Part off, and reverse in the chuck so that the top may be domed, this can be done with a file, finishing with emery cloth. The spring may be about 22 s.w.g. piano wire wound 12 t.p.i. Assemble and check all fits and movement, and ascertain that the pin can be withdrawn sufficiently to pass over the fingers when rotated. It is important that there should be no play between the detent pin and the body. If everything is found to be correct, assemble on the support bar, screw on the cap on to the end of the pin and lightly rivet over.

The Back Centre Support Bracket (23)

A length of $\frac{7}{8}$ in. diameter shafting can be used for the bar, or 12 s.w.g. steel tubing will do. The bracket itself is shown in Fig. 29. and is an iron casting. I have not bothered to give a drawing of the pattern, as it is the same as the finished article except about $\frac{1}{8}$ in. should be added to the ends of the bearings to allow for machining.

Mark the centre of the large boss and scribe a line through the centre of the small one, and then mount on "V" blocks on the cross-slide, packing them up so that both bosses are at centre height as shown in photograph No. 30. Place the bar on the cross-slide in such a position that it will be possible to bore and drill both bosses without making a second adjustment. Commence by centre drilling the large boss, then drill right through with $\frac{1}{4}$-in. drill and follow up with increasingly large ones to, say, $\frac{3}{4}$ in. diameter, then finish to size using a boring tool gripped in the four-jaw, the size of the hole being controlled by adjusting two of the jaws only to move the tool eccentrically.



BACK CENTRE SUPPORT (23)

Fig. 29

When finished so that it is a nice fit on the $\frac{7}{8}$ in. bar, replace the four-jaw with the headstock drill chuck, and fit a centre drill. Now feed the cross-slide 40 turns back allowing for any backlash, and centre drill the small boss, open it up right through, and finish with an 8-mm. drill.

A $\frac{1}{2}$ in. B.S.F. tap is now mounted in the four-jaw and set to run true, and the thread cut in the small boss, the carriage must be helped forward by pressure on racking wheel. I found this method quite accurate, and considerably quicker than machine cutting the thread, which entails considerable risk that the two bosses would not be in line.

As neither of the bosses have bearing faces, they may be spot-faced using the pillar drill, or against the tailstock drill pad.

(To be continued)

"Britannia" in $3\frac{1}{2}$-in. Gauge

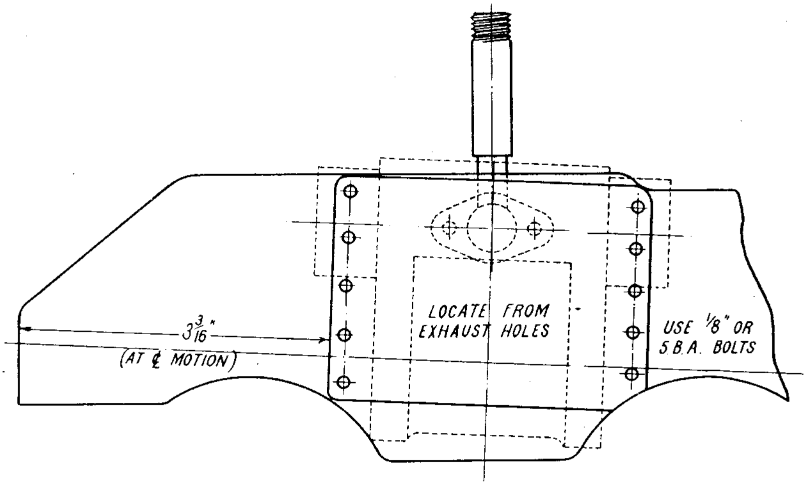
Cylinder Assembly and Erection

by "L.B.S.C."

As there are no steamchest joints to bother about, and no oblong gaskets with umpteen screw or studholes to cut and fit, assembling the cylinders is an easy job. The best way I know of packing small pistons, so that they are steam-tight, but perfectly free in the bore, is to use a "piston-ring" made from square braided graphited yarn. The groove in the piston should just be wide and deep enough to take this without excessive squeezing. Cut a length long enough to overlap by about $\frac{3}{16}$ in., or $\frac{1}{4}$ in. if you like, and cut off the ends at an angle, like the joint of a metal piston ring, so that when the scarfed ends are placed together, they form the original shape, viz. a $\frac{3}{16}$ in. square. Put the ring of packing in the groove, and enter it into the cylinder, prodding judiciously with a screwdriver tip or knife blade, if it needs any persuasion. I found by experiment, long ago, that piston packing doesn't need to be mechanically tight; and the old idea of making a piston in two parts, and screwing them together to force the packing into close contact with the cylinder bore, was just plumb crazy, inasmuch as it increased the friction, and reduced efficiency in the very place where it is most useful. As it is the "piston-push" that does the doings, the idea should be, to get the maximum push with the minimum pressure; and the veriest Billy Muggins should be able to appreciate what happens when there is frictional resistance to piston movement. However, there are still lots of prejudiced folk who can't see the wood for trees! All I know is, that the pistons on my own locomotives don't blow, and yet the engines coast freely with steam shut off; even when cold, they will run freely along the line if they are given a push. The springiness of the graphited yarn, kept moist by the heavy-grade cylinder oil, keeps the pistons steamtight, whilst allowing perfect freedom to slide.

The pistons, naturally, fit the cylinder bores as they should do, so that the rings of graphited yarn have little more to do, than act as a seal. In days gone by, when I did a bit of reconditioning for friends, I came across some shining examples of piston "fitting"; and in several cases, found that the packing had disintegrated, and the bits had blown completely away, owing to the narrowness of the "lands" on either side of the packing groove, and the shocking "fit" of the piston in the bore. I've more than a suspicion that the advocates of the packing-squeezing antic, "fitted" their pistons in this way, and relied on the packing to make up for bad workmanship!

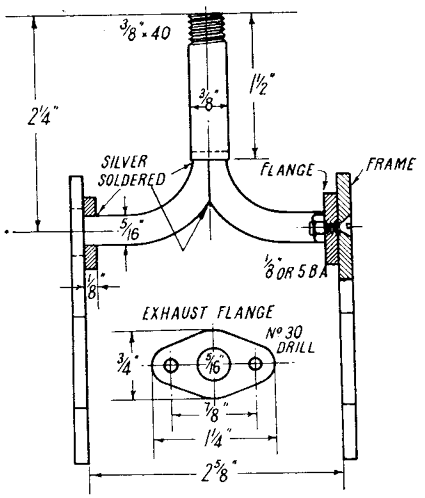
If the ends of the cylinders, and the cover flanges, are truly faced, as they should be, gaskets of thin brown paper, smeared with cylinder oil, are all that will be needed to ensure steamtight joints. I usually cut out the paper ring, put it over the register on the cylinder cover, put same in place, and put the screws straight in, letting them make their own holes in the gasket. Thick gaskets are a mistake, as they dry out, crack, and start to blow between the screwholes. On the above-mentioned reconditioning jobs, when the contact faces were



How to locate cylinders

nothing to write home about, I used gaskets of 1/64 in. Hallite, which proved quite satisfactory, as it doesn't crack. No jointing is needed in the steamchest covers, but smear the piston-valve with cylinder oil before inserting. The piston gland is packed with a few turns of graphited yarn (ordinary strands, not braided) and that doesn't need screwing up too tightly, either.

The flange plates, by which the cylinders are attached to the main frames, may be either cut from $\frac{3}{16}$-in. brass plate, or machined up from castings. In the latter case, it is just a matter of chucking them truly in the four-jaw, and facing off with a round-nose tool set crosswise in the rest. Note, however, that both sides have to be faced, and they must be true with each other; if not, the piston-rod and valve-spindle won't work parallel with the frames, and the crosshead will bind in the guide-bars. It is no trouble to



How to erect exhaust pipes

have them right; when reversing, to face the second side, put a true piece of packing between the jaw faces and the machined side of the cover, and press the cover against it whilst tightening up the jaws. I keep several odd pieces of ground flat stock, for jobs like this.

The shape of the plate was given, with dimensions, in the November 29th issue, along with the section of the complete cylinder, and the end view. Cut the piece to the size given, or if a casting, file or mill to size; then mark off and drill the $\frac{1}{2}$-in. hole, also drill and countersink the holes for the 6-B.A. screws attaching the plate to the cylinder. Leave the end holes for the time being. Scribe a line across the plate, $\frac{1}{2}$ in. from the bottom, on the side opposite to the countersinks; then lay the plate on the frame in its correct position, with the chassis on its side on the bench. My pet way of holding a locomotive chassis on its side, so that it doesn't shift, and I can turn the wheels if needed, is to hold one end of the buffer or drag beam in a machine vice, with a bit of packing under the end of the beam at the other end, to keep the whole issue level.

Poke a bit of $\frac{1}{2}$-in. rod through the exhaust holes in plate and frame, and line up the scriber mark with the centre-line of motion scratched on the frame plate; the plate is then correctly set. Clamp temporarily in position with a toolmaker's cramp, and mark any place that overlaps the frame; for example, the bottom corner of the bogie wheel opening. Remove plate, file away the unwanted bits, and then mark out and drill the five No. 30 holes for the fixing bolts at each side, 5/32 in. from the edge, and spaced as shown in the accompanying illustration, filing off any burrs.

Now replace the plate, taking great care to have the scribed line near the bottom of the plate, parallel with the line of motion, when the bit of $\frac{1}{2}$-in. round rod is in position in the exhaust holes. Fix temporarily with a toolmaker's cramp as before, and drill No. 30 holes through the frame plate, using those in the flange plate as guide. Then, when the cylinders are attached to the flange plates, and the latter bolted to the frames, the former will be well and truly erected, O.K. for the guide-bars and motion work. Warning—don't forget the flange plates are right- and left-handed; when locating them on the frame the countersunk side of the screwholes should be next to frame.

The flange plates can now be attached to the cylinders. If you refer back to the illustrations which appeared in the issue for November 29th last, you'll see that the top and bottom of the flange plate is level with the top and bottom of the cylinder bolting face, and projects $\frac{7}{16}$ in. at each side. Temporarily clamp the flange plates to the cylinders in this position—a big toolmaker's cramp is needed, or you can use a couple of bits of bar, with long bolts at top and bottom. You would have been amused to see the way young Curly fixed up his jobs; the poor kid hadn't much in the way of cash, but made up for it with weird and wonderful improvisations! Run the No. 34 drill through the countersunk holes in the flange plates, making countersinks on the cylinder bolting faces; remove plate, drill the countersink marks No. 44, and tap 6-B.A. Before assembling, make sure that the contact faces are true, by rubbing both the bolting face of the cylinder, and both sides of the flange plate, on a sheet of fine emery-cloth laid on something flat, such as the drilling-machine table. I use a piece of plate glass from an automobile windscreen. Smear the contact faces with plumbers' jointing, and attach the flange plate to the bolting face of the cylinder with fifteen 6-B.A. countersunk-head screws. The countersinks must be deep enough to prevent the screwheads projecting from the surface, as this has to make a good sound joint between the flange plate and frame, when the cylinder is erected "for keeps."

It would be as well, if the exhaust pipe assembly is now made and fitted, because the flange plates will cover the screw heads in the exhaust flanges, when the cylinders are erected. First of all, cut out the two oval flanges from $\frac{1}{8}$-in. brass plate, to the sizes given in the illustration, and drill the holes. As they must be perfectly flat and true on the contact side, give them a dose of the same medicine as administered to the flange plates,

which should cure any irregularity. The next requirement will be two pieces of $\frac{5}{16}$-in. copper pipe, about 22-gauge, and about $1\frac{3}{4}$ in. long. These have to be bent as shown in the illustration. If you try to bend them in the ordinary way, they will probably kink, so they should be filled with lead. An esteemed friend now, alas ! on the other side of the Great Divide (my old friends have practically all departed) gave me some coils of lead wire of various diameters ; and all I have to do, to prepare a pipe for bending, is first to soften it in the usual way, then poke a piece of the lead wire, of suitable diameter, into the bore, and go ahead and bend. The pipe is then cut to length, and the lead core melted out. This process, by the way, I use only for pipes over $\frac{1}{4}$ in. diameter, and then only if the bends are sharp. I bend small pipes with my fingers.

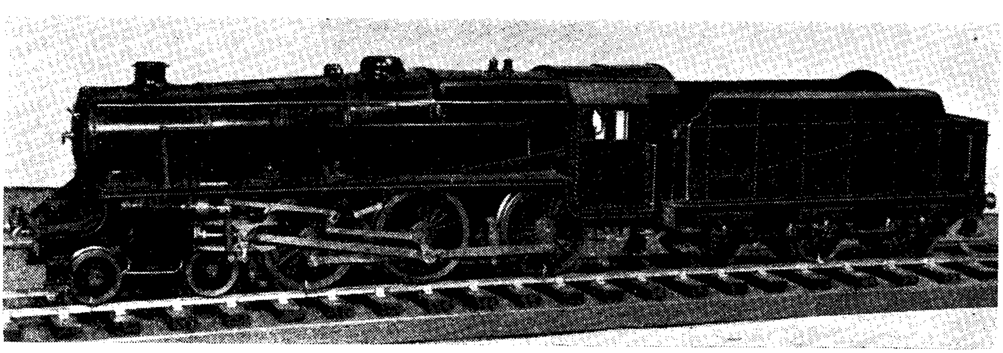
In the present instance, a piece of pipe 6 in. long or thereabouts, should be softened and filled with lead. Plug the end and hold it in the bench vice ; and if you have a steady hand, the lead can be poured in from the lip of a plumbers' iron ladle. Sand, or melted resin, can also be used. When the lead has set and the pipe is cool, hold one end in the bench vice, and put a piece of iron gas pipe on the other end, to give the necessary leverage. The copper pipe can then easily be bent to the required curve, and will not kink. Cut off the bend to the required length, and ditto repeato the operation. The lead can then be melted out of the pieces of pipe. File off one end of each bend, as shown in the illustration, until the two parts, placed together, are the size and shape of a single pipe when viewed end-on.

Now cut a piece of $\frac{3}{8}$-in. copper pipe of about 20-gauge, to $1\frac{1}{2}$ in. length, and put a few $\frac{3}{8}$ in. $\times$ 40 threads on one end. A fine thread is necessary, as a deeper one would weaken the pipe, and it might break off when screwing on the blastpipe nozzle. If you haven't 40, use 32, but be mighty careful when screwing ; if the die is wetted with the cutting oil used for turning steel (at present I'm using "Cutmax" diluted with half its bulk of paraffin) the threads should be clean. Assemble up as shown in the illustration. Put the flanges on one end of each bend ; they should be a tight fit. Butt the filed-off ends together, and insert them in the plain end of the $\frac{3}{8}$-in. pipe ; after which, the joints can be silver-soldered. After pickling and washing off, give the flanges a rub on the emery-cloth again, in case any silver-solder has oozed through on to the contact faces. Drill two No. 30 countersunk holes in each frame, at $\frac{7}{16}$ in. each side of the centre of the $\frac{1}{2}$ in. exhaust hole, and level with it File off any burrs, rub the emery-cloth over the inside of the frame, around the holes, smear the flanges with plumbers' jointing, put the assembly between frames in the position shown in the illustrations, and secure with $\frac{1}{8}$-in. or 5-B.A. countersunk steel screws, nutted on the inside of the flanges, as shown in the assembly view. There is enough flexibility in the soft copper pipes, to allow the flanges to bed home against the inside of frame ; and in any case, there is only exhaust pressure to withstand, and that isn't much on Curly engines !

Don't bother to fix the cylinders permanently in position yet, but just attach them temporarily with two or three bolts in each. If the piston-rods are pulled out to their full extent, they should line up with the centre-line of motion, as marked on the frames. Next stage, guide-bars, crossheads and connecting-rods.

Another Fine "Black Stanier"

The reproduced photograph shows another example of the ever-popular *Doris*. She is the result of four years' work by the hon. secretary of the Whitefield and District S.M.E., Mr. A. Stevenson—incidentally, the right name for a locomotive builder, even though the spelling is a little different !—and is a really creditable job, as can readily be seen. Our worthy friend certainly has a very "straight eye," judging by those lines of rivet heads on cab, tender, and elsewhere ; they would send my old friend "Bill Massive" into the seventh heaven of delight. As every hole was drilled by hand, the work is all the more worthy of the highest commendation. The sand boxes on the running-board are used as lubricators, pipes being led from them to the axleboxes, and the water and oil pump eccentrics. The tender is made from sheet steel, with a brass tank inside it. The engine works as well as it looks, the boiler being an excellent steamer ; and she won the Championship Trophy for the best entry by a member of the Northern S.M.E. Association, at their 1951 exhibition.



Mr. A. Stevenson's "Doris"

Novices' Corner

Box Spanners

BOX spanners are used for loosening or tightening nuts that are inaccessible to an ordinary open-ended spanner, or to obtain a more secure hold. Box spanners are usually made from tube and are provided with two tommy holes set at right-angles to one another. In order to save material, commercial box spanners are generally made double-ended, that is they have a different spanner size at each end of the tube. A typical example is seen in Fig. 1 where the type of spanner issued with a motor-cycle tool kit is illustrated. One advantage of this form of box spanner is that a number of these tools of different sizes can be packed one within the other—a most convenient arrangement when the spanners have to be stowed away in a small tool bag.

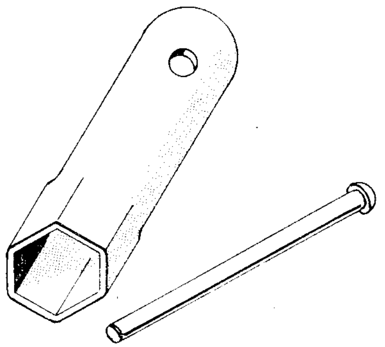


Fig. 1. Common box spanner and tommy-bar

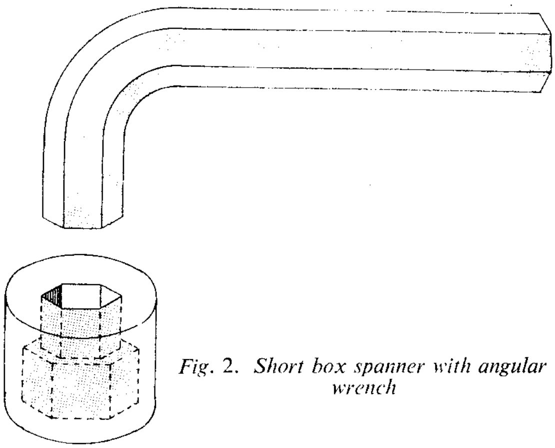


Fig. 2. Short box spanner with angular wrench

Another form of box spanner designed for heavy duty is the tool illustrated in Fig. 2. This spanner is made from a piece of heat-treated steel and has the correct nut-size hexagon at one end. At the opposite end a hexagon hole is formed to accommodate the spanner-key. At each end of the key there is a ball detent to keep the spanner from falling off the key when in use.

There are, of course, several varieties of this form of box spanner, and these can all be found in tool catalogues.

Making Box Spanners

It often happens that some piece of work requires a box spanner of a special size, or of a size not immediately available. In these circumstances the worker is confronted with the alternative of making a special spanner or waiting until the correct spanner can be obtained.

The experienced worker will, of course, at once set about making a spanner in one or other of the ways here described.

The first method may be employed when speed is essential, for this enables a serviceable spanner to be quickly made.

A nut or a piece of hexagon steel is used as a former and the piece of tubular material for the spanner is slipped over the former and hammered until the correct hexagon form is imparted to the work.

The size of the hole in the tube is important, for results will be disappointing if this dimension is not approximately correct. It has been found, in practice, that a hole equal in diameter to the distance across the corners of the hexagon will serve for a spanner that is to be formed quickly. A piece of tube of the correct size, however, will not always be available and the worker must, therefore, make a tube by drilling or boring a length of bar material. The end of the bar should be faced and centre drilled in the lathe. The work is then drilled and, if necessary, the bore is finished with a small boring tool so that when the outside of the bar is turned, the wall will be of equal thickness and strength all round. The boring should be carried to a depth a little greater than the length of the nut that the spanner has to fit. The thickness of the wall of the tool should be kept to about 1/32 in. for all spanners up to 2-B.A. size ; if too great a wall thickness is left, there will be difficulty in shaping the hexagonal end. The hammering down process is carried out with the work resting on a brass block gripped in the vice. When the hammering has produced a regular shaped hexagonal end to the spanner, the work may be gently squeezed in the vice, gripping each pair of flats in turn, until the spanner fits the nut.

The flats and the end of the spanner should now be finished with a fine file and the shank polished with emery cloth. If desired the spanners may be given a blued finish by heating them either in a sand-bath or by placing them, on a copper gauze mat, over an electric boiling ring. Both these methods will heat the work evenly and produce a uniform finish. The object of the copper gauze is to prevent the work coming in contact with the heating element. When the element is totally enclosed, as in many domestic electric cookers, no gauze is needed. The second method is somewhat similar to the first, but, instead of compressing the material on to the hexagonal former, the tubular material is expanded by driving the former into the work and, in this way, a neater and more workmanlike tool will result. The former is a short length of hexagon bar of the correct nut size and is given a short taper to facilitate entry into the mouth of the hole. The tool should be case-hardened, otherwise the corners of the hexagon may be damaged and the spanner will then be too small to engage a nut.

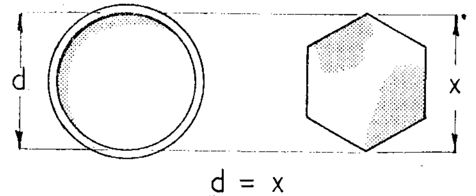


Fig. 3. Relation between spanner blank and former

A former for box spanners is illustrated in Fig. 4. When the former has been entered for the full distance into the work the tube is carefully hammered down on to the flats of the hexagon. When the expansion method of making a box spanner is used, the size of the hole in the work is of great importance. The circumference of this hole should be approximately equal to the perimeter of the hexagonal former. The dimension required is given by the formula $d = 1.103\ x$ where d is the size of the hole and x the distance across the flats of the hexagon, as shown in Fig. 5.

Other Forms of Box Spanners

One of the advantages of making box spanners, as opposed to buying them, is that the length and form of the spanner can be made to suit the work in hand. Thus it may be necessary to produce special short spanners similar to those illustrated in Fig. 6. Again, a comparatively large nut housed in a recess may need a thin-walled spanner like that illustrated in Fig. 7 at *C*.

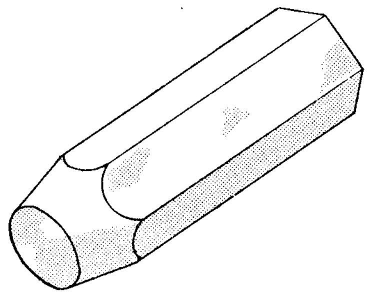


Fig. 4. Former for making box spanners by the expansion method

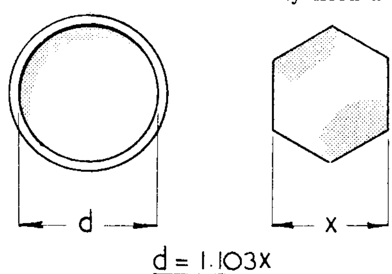


Fig. 5. Relation between blank and former—expansion method

As will be seen, some box spanners are provided with holes for tommy bars, whilst others

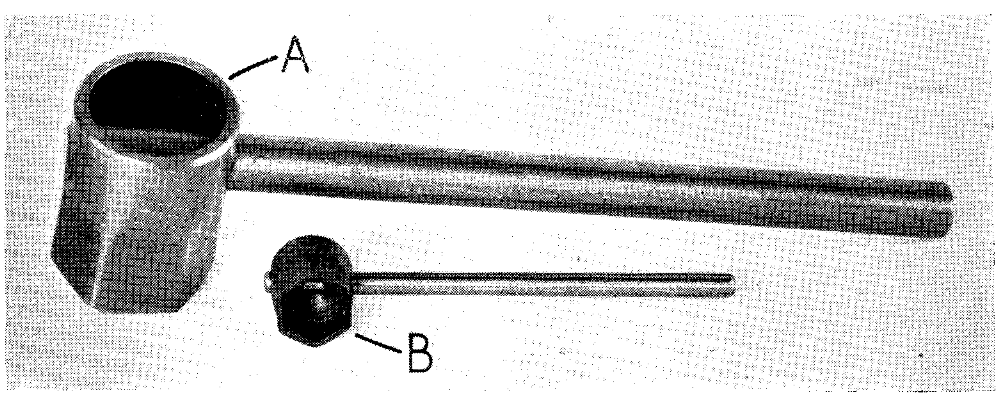


Fig. 6. Short spanners fitted with tommy-bars. ("A") $\frac{3}{8}$-in. B.S.F. ; ("B") 2 B.A.

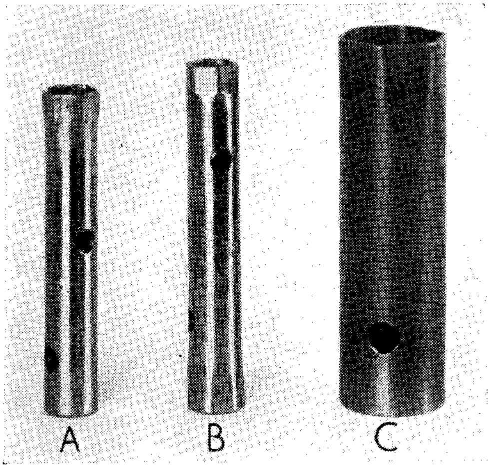


Fig. 7. Three tubular box spanners. ("A") 4 B.A.; ("B") 4 B.A. and 5 B.A.; ("C") ⅜ in. B.S.F.

have tommy bars permanently fitted in place. The best way of securing the bar is to turn down one end for a distance equal to rather more than the outside diameter of the box spanner. The tommy bar may then be riveted over as illustrated in Fig. 8. To maintain its strength, the tommy bar should not be greatly reduced in diameter and a reduction of some 0.020 in. will

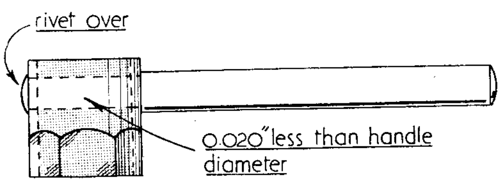


Fig. 8. Short box spanner with handle secured by riveting

be found sufficient. Mild-steel is rather too weak for making these tommy bars and silver-steel will be found to serve better.

Tee-handled Box Spanners

Box spanners that are provided with fixed tommy bars usually have the bars secured by

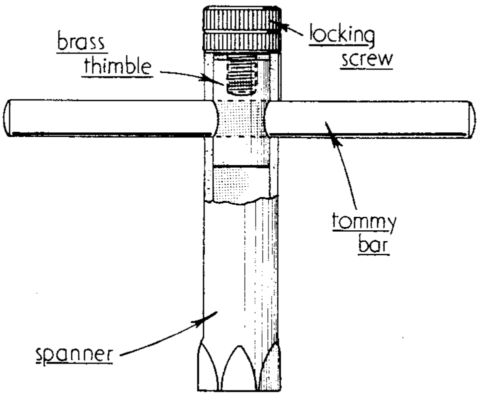


Fig. 9. Tubular box spanner with adjustable handle

making them a press fit in the spanners. This practice has little to commend it except, of course, that it is a simple and inexpensive method. Sooner or later, however, tommy bars secured in this may come loose and are, then, lost. Moreover, when they are pressed into the spanners, the bars are scored and roughened; this damage spoils the general appearance of the spanner and is difficult and troublesome to put right.

The most satisfactory way of securing a tommy bar in a tubular spanner is illustrated in Fig. 9. As will be seen, the spanner is provided with a brass thimble that fits the bore of the tube easily. The thimble itself is drilled and tapped axially to receive the locking-screw, and is also cross-drilled to accommodate the tommy bar. When the locking-screw is turned clockwise, the thimble is drawn upwards and the bar is then held securely in any required position.

If this method is used, both the spanner and the tommy bar may be highly finished, since no damage to the tool can occur when fitting the bar in place.

A tool much used in small assembly work is the box spanner fitted with a wooden handle, illustrated in Fig. 10. After the shank of the spanner has been threaded and screwed into the wooden handle, it is secured with a cross-pin. However, a steel ferrule is first pushed over the end of the handle to keep the wood from splitting and to afford a seating for the cross-pin. The handle

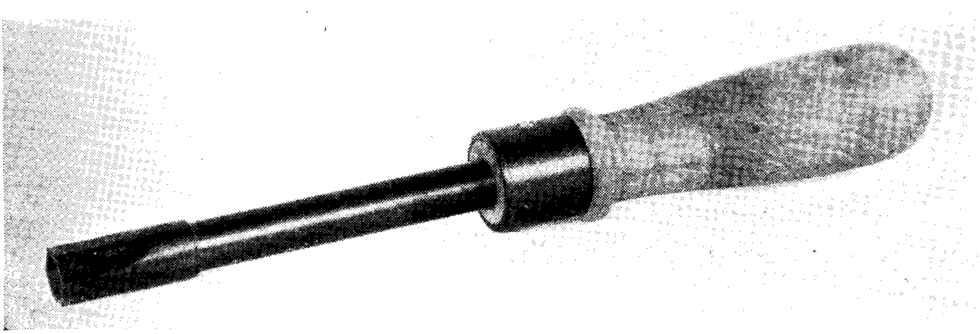


Fig. 10. Wooden handled box spanner

should be turned from hardwood, as this material can be threaded satisfactorily. If a piece of boxwood is available, a very durable handle of good appearance can be made. This type of spanner is made from a piece of mild-steel rod of a size that will allow the head to be machined to the correct outside diameter for forming the hexagon. The shank is then turned down and threaded, and it will be found that a ¼ in. diameter shank threaded ¼ in. B.S.F. is fully strong for all small spanners. However, above No. 4 B.A., the finished spanners look somewhat out of proportion if the shank is not increased to $\frac{5}{16}$ in. in diameter.

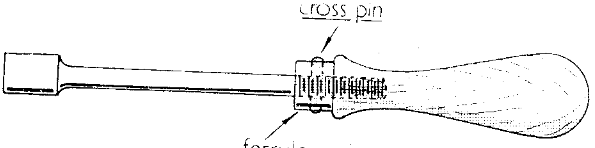


Fig. 11. Method of fixing shank of spanner to wooden handle

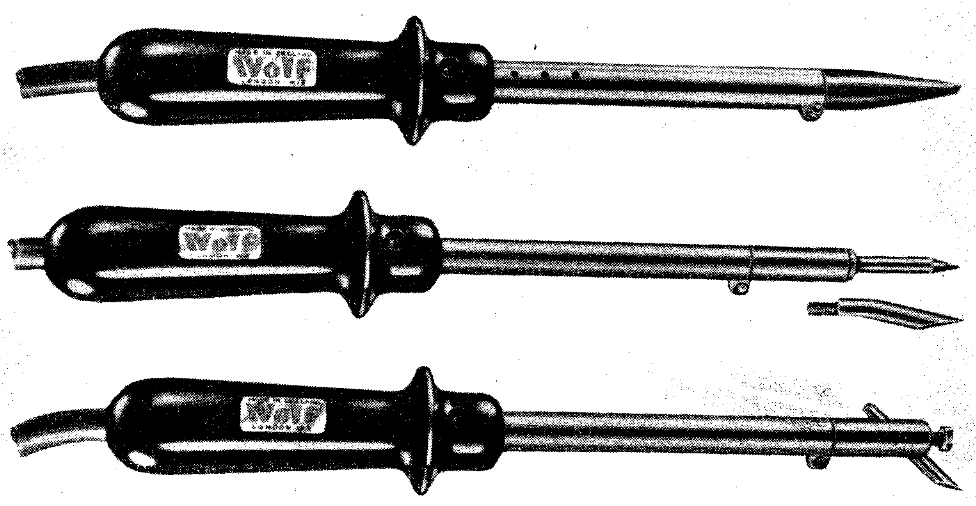
If an especially good appearance is needed, the handles may be french polished when revolving slowly in the lathe. When a somewhat better grip is needed, the fitting of fluted or octagonal handles is advised. Handles of this pattern, however, cannot be french polished when revolving, but must be held in the hand for the purpose.

WOLF ELECTRIC SOLDERING IRONS

NEW additions to the range of Wolf Electric Soldering Irons have recently been announced and all these are of the straight handle type. They comprise three models—Types 22, 32, and 42, which, whilst retaining all the general features so popular in the original range, have been designed to meet the demand for conventional straight handle types of Wolf design and manufacture.

Amongst the first important users of these new models was the G.P.O. Engineering Department. To them, the straight handle soldering iron was indispensable in their work, involving as it does the daily soldering of many thousands of connections in telephone exchanges throughout the country. In this respect they were desirous of standardising upon an electric iron of unusually high efficiency in a range of models for all standard voltages to meet the consistent and exacting requirements of constant use.

In keeping with all other models, the heating elements are designed to concentrate heat on the working point providing a rapid and constant heat. They are sturdily built to withstand heavy usage and are fitted with hard wooden handles with a heat deflecting skirt.



TEST REPORTS

Some expert comments upon items submitted by the trade

The Cowell Shaping Machine

As visitors to the 1950 Model Engineer Exhibition may have learnt, Messrs. Cowell, of 7a, Sydney Road, Watford, supply sets of machined castings and materials for constructing a hand-operated shaping machine of 6 in. working stroke.

Messrs. Cowell have, however, completed a few of these shapers solely for demonstration purposes, and we have been asked by the makers to report on one of these finished machines.

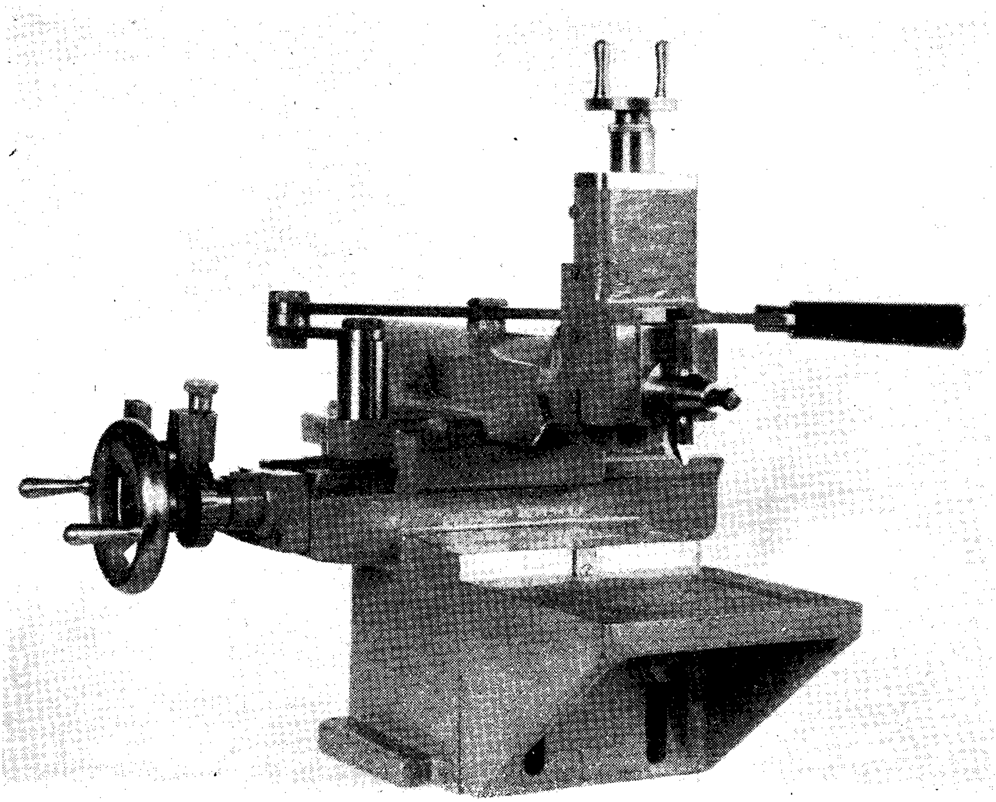
As the manufacturers do not intend to market the machine in its finished form, there would be little point in referring in detail to the accuracy and high finish of the example under review.

These notes will, therefore, deal rather with the design and general construction of the machine, and reference will also be made to the suitability of the shaper for use in the small workshop. In the first place, this machine, like others supplied by this firm, is so designed that the necessary machining can be carried out in a $3\frac{1}{2}$-in. lathe; this is a strong point in the design and one that will appeal to the majority of amateur workers.

Constructional Details

The base is a rigid box-form casting planed on its under surface and drilled with four conveniently placed holes for securing the machine to the bench. Unlike some small machines there is, here, no need to alter the shape of the bench top when mounting the shaper in place.

The carriage slides, $3\frac{1}{2}$-in. in width, are formed integrally with the main casting on the upper surface of the base.



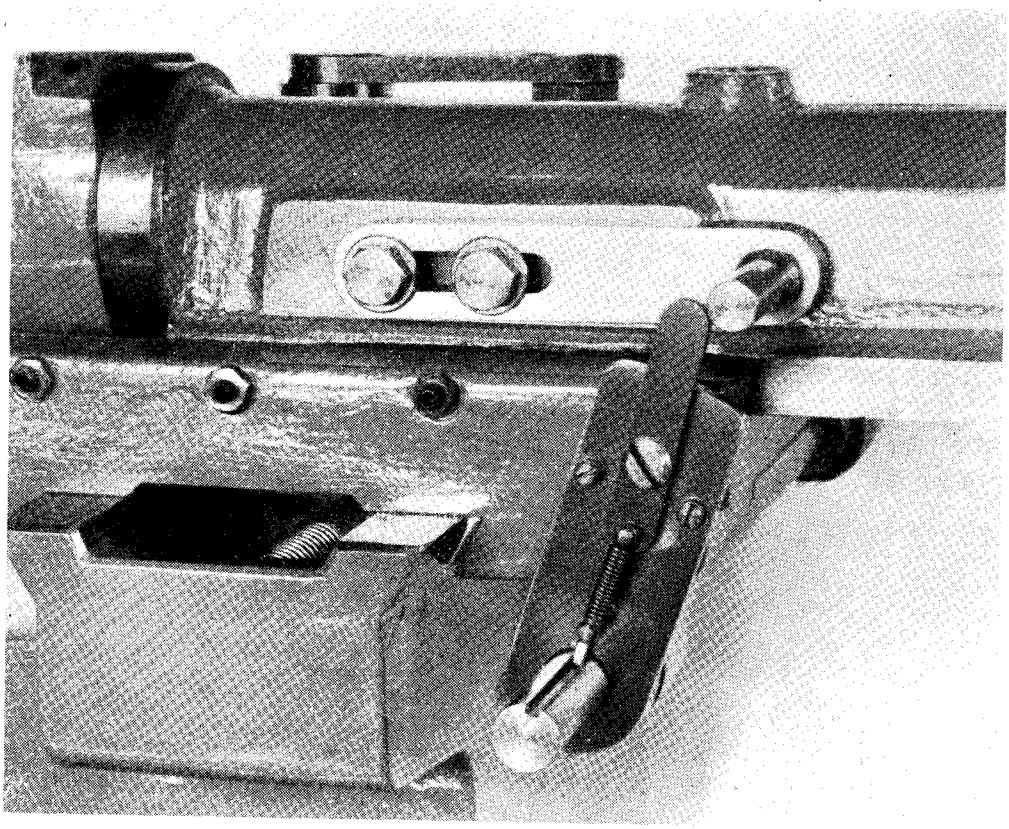
The Cowell shaping machine

The table takes the form of an angle plate, deeply webbed at both sides but open in front; this casting is secured to the machined front face of the base, and slides vertically for height adjustment on a large feather or key. The upper surface of the table is furnished with two slots, $\frac{7}{16}$ in. in width, for securing the work or a machine vice in place, and we understand that the makers are introducing a suitable vice for use with the machine. The work surface of the table measures fully 6 in. × 6 in., and during the construction of the machine this surface can be accurately tooled by means of the shaper itself.

For some angular machining work it might be found convenient to remove the key and set the table itself to the required angle with the aid of a protractor. Moreover, if the work has to be secured vertically to the side of the table, the table webs could quite easily be tooled in the machine itself and then slotted to take clamp-bolts. When the table is lowered to the full extent and the tool slide is fully raised, a working distance of 4½ in. is obtained. The ram carriage is a robust casting that slides on the carriage ways, already mentioned, and the gib strip fitted is furnished with Allen adjusting screws secured by lock-nuts. In connection with this and the other gib strips fitted to the machine slides, there are two small but important constructional details: the gib is end-located by means of register pins, and the lock-nuts of the adjusting screws bear on machined surfaces.

The carriage is traversed by means of a feed-screw of ½ in. dia., machined with a left-handed square thread of 1/10 in. pitch.

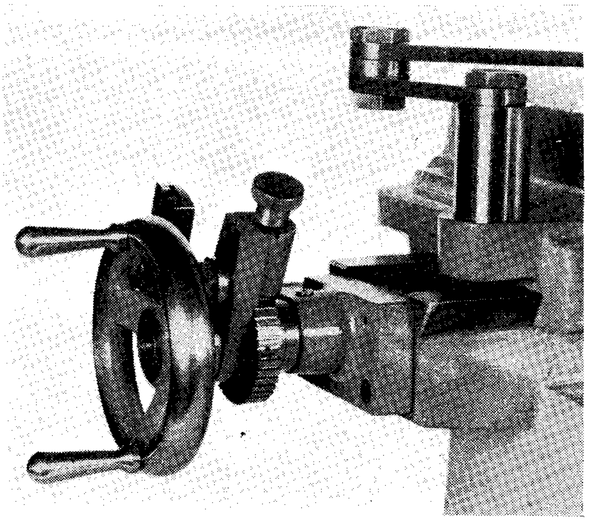
The bronze feed-nut is of ample proportions, and the keep-plate is very rightly fitted with register pins to ensure correct alignment. The fixed thrust and the adjustable thrust collars all have large bearing surfaces. Although, as yet, no index is fitted to the feed-screw, the manufacturers apparently refer to this in the instructions issued for building the machine; in any case, there should be no difficulty in combining this most useful adjunct with the inner adjustable thrust collar. When pointing out this omission we have in mind the operation of cutting a keyway in a shaft, where the width of the tool is first measured with the micrometer and, after the tool has been set on the centre-line of the work, the tool is fed outwards for an exactly equal distance on either side of the centre line.



The automatic feed mechanism with its trip lever

The ram, consisting of a box-form casting of great rigidity, travels in the V-slides, 2¾ in. in

width, machined on the upper surface of the carriage. At the end of its outward stroke, the ram is in engagement with the ram slides for a distance of $5\frac{1}{2}$ in. and then has an overhang of $4\frac{1}{2}$ in. The circular ram-head is indexed with highly-finished, machine-cut graduation lines extending to 45 deg. on either side of the zero line. The base of the tool slide is pivoted on this portion of the ram-head, and is secured in place by means of two $\frac{5}{16}$ in. dia. Allen screws, bearing on soft metal pressure pads to avoid injuring the clamping surfaces. The hand lever for operating the ram exerts a leverage of approximately 2 to 1, and is secured to a swing link pivoted on the carriage casting; this allows the screw fitted to the ram to work in a circular hole in the lever, instead of in an elongated slot.



The ratchet mechanism of the automatic feed

The tool slide is machined with V-slides for engagement with the tool slide base attached to the ram-head, and a well-designed gib strip is fitted. The feed-screw is cut with a V-thread of $\frac{3}{8}$ in. dia. $\times$ 20 t.p.i., and engages directly in the base casting for a sufficient distance to ensure lasting wear. At its upper end and immediately below the feed handle, the feed-screw carries an adjustable index, again, very neatly machine-graduated in thousandths of an inch. As before, the keep-plate is fitted with register pins, and the working travel of the tool slide is fully 2 in. The housing for the clapper box is cast integral with the tool slide itself, so that it is not possible to give additional relief to the tool when machining a vertical face or an undercut surface. This difficulty may, in part, be overcome by locking the clapper, but the clearance at the tool's cutting edge is then apt to be quickly worn away, especially when bronze is being machined. There would, however, be little difficulty in making and fitting a swivelling clapper box to the existing casting, and the makers are apparently prepared to supply a casting suitable for the purpose.

The clapper has a parallel hinge-pin, but wear of this part can be more easily taken up if a tapered pin is fitted; moreover, an oilway might well be drilled for lubricating the joint.

The toolpost with its clamp-screw and base collar are of the well-tried American pattern, but in commercial practice it is not unusual to find that all three of these parts are hardened to resist wear. The automatic feed gear appears to be well designed and of straightforward construction.

A rocking shaft to operate the feed is carried in two bearing brackets at the rear of the machine. A trip lever, attached to this shaft by means of a sliding key, is actuated by means of a finger secured to the ram. The details of the parts forming the trip mechanism are shown in the accompanying photograph, and this type of trip lever, fitted with a spring-loaded wiper, will be found more certain in action than the solid, forked lever sometimes used. At its left-hand end the rocking shaft carries a T-slotted feed lever coupled to the ratchet lever by means of a link. The T-slot allows the link to be raised or lowered in order to vary the amount of the automatic feed.

The ratchet lever, pivoted on the end of the carriage feed screw, is fitted with a pawl to engage in the teeth of the ratchet wheel attached to the feed-screw. This pawl can be turned from the neutral position so as to traverse the carriage in either direction. The ratchet wheel has 40 teeth, and the movement of the ratchet lever can be adjusted to turn the wheel for a distance corresponding to one, two, three, or four teeth. This adjustment enables the carriage to be traversed automatically for a distance of from $2\frac{1}{2}$ to 10 thousandths of an inch for each stroke of the ram handle.

For the lubrication of the slides and the feed-screws, oil can be directly applied, as the parts are sufficiently exposed. The bearings of the carriage feed-screw and the feed shaft are fitted with lubricators of the Bennet type.

Conclusion

All castings are well proportioned and of robust design, and there should be no difficulty in carrying out the machining operations indicated in the excellent set of blueprints and instructions supplied. Adequate provision has been made for carrying out adjustment and taking up wear in the slides and feed spindles. All bearings appear to be of ample size for the loading they have to bear.

The eminently practical design and the robustness of the working parts should ensure a long and trouble-free working life, and the finished machine may well be superior to most small hand-operated shaping machines obtainable at the present time.